Heating · Piping and Air Conditioning

Volume 6, No. 8

AUGUST, 1934

AIR CONDITIONING *in the treatment of* Pollen Asthma

By **Tell Nelson, M.D., B. Z. Rappaport, M.D., A. G. Canar, B.S., and William H. Welker, Ph.D.***

IN RELIEVING pollen asthma and hay fever sufferers air filtration and air conditioning fulfill one of their most popular roles. Supplementing previous studies on filtered air, the work reported here demonstrated the importance of maintaining a relatively low humidity and constant temperature in addition to efficient filtering. The explanation of the test set-up is also suggestive of the care which must be used in selecting and installing filters for removal of pollen from the air

DURING the hay fever seasons of 1931 and 1932, we studied the effect of air filtration on the alleviation of symptoms of hay fever and pollen asthma on 181 patients.[1] We observed that relief from hay fever symptoms occurred in from fifteen minutes to several hours after entering our filtered air ward, but that relief from asthma depended upon the severity of symptoms. The time required for relief of symptoms of asthma varied from twenty-four hours to several days.

During the 1932 period of observation, it was noted that in spite of confinement in a pollen-free room, pollen asthma patients who were free of symptoms, developed attacks of asthma shortly after the occurrence of storms. These attacks were severe and lasted several days. This observation led us to conclude that other factors in addition to pollen were responsible for the occurrence of asthma in pollen sensitive individuals. The factors to be considered are: Increase in the relative humidity, changes in temperature, changes in barometric pressure or a change in the ionization of the air during storms.

In the experiments conducted during the 1933 pollen season and reported here, our ward was provided (in addition to equipment for filtration of the air) with equipment for the control of the relative humidity and temperature within narrow limits. The relative humidity was maintained between 15 and 30 per cent, and the temperature between 74 and 80 F, irrespective of the outdoor fluctuations.

The Dehumidifying and Filtration Apparatus

The apparatus[2] used in this experiment consisted of three parts—a circulating system, a dehumidifying system and a filtration system (Fig. 1). Dehumidification was accomplished by a silica gel dehumidifying unit, which consisted of an absorber, an absorption fan, an after-cooler, an activation fan, and an activation furnace. The absorber consisted of a cylinder 36 in. in diameter and 24 in. high, mounted on a vertical shaft which is rotated by a motor and suitable speed reducer. The cylinder has stationery heads to which are connected the ducts leading from the fans, activation furnace and after-cooler. The gel cylinder is rotated 3 revolutions per hour by a speed reducer and a 1125 rpm, 1/12 hp motor. The gel cylinder contains 24 pie-cut shaped sections, one-half of which are always absorbing moisture out of the air, while the balance are being activated—having the absorbed moisture driven off by passing hot furnace gases through them. Air to be dehumidified is forced through the gel beds by the absorption fan. The dried air leaves the absorber at a temperature of about 140-150 F, because the latent heat of vaporization is

*From the Departments of Physiological Chemistry and Medicine, College of Medicine of the University of Illinois, Chicago, Ill.

[1]See "Filtered Air Relieves Hay Fever," by William H. Welker, B. Z. Rappaport, and Tell Nelson, HEATING, PIPING AND AIR CONDITIONING, July, 1933, pp. 348-350.

[2]The authors wish to acknowledge the assistance rendered by the Peoples Gas Light and Coke Company, Chicago, in supplying and installing the equipment for dehumidification and cooling, and for the technical assistance rendered during the conduct of the experiment; and the assistance rendered by the American Air Filter Company, Louisville, Ky., in supplying and supervising the operation of the air filter units.

Studies reported here show dehumidification and temperature control, with efficient filtration, valuable in treating pollen asthma and hay fever

Table 1—Absolute and Relative Humidity of the Air before and after treatment with Silica Gel and the Absorption Efficiency of this Dehumidifying Agent: and the Absolute and Relative Humidity out-of-doors and in the Experimental Ward and the Drop in Absolute Humidity in the Air Conditioned Ward as Compared to the Out-of-doors.

		Air intake at Dehydration unit		After Silica Gel treatment			Out-of-door		In experimental ward		
		Grains H_2O per pound of air	Relative Humidity in %	Grains H_2O per pound of air	Relative Humidity in %	Absorption efficiency in %	Grains H_2O per pound of air	Relative Humidity in %	Grains H_2O per pound of air	Relative Humidity in %	Drop in Absolute Humidity in %
Date	Time										
Aug.											
21	9:30 a. m.	..	..	..	..	..	96	62	38	30	60.5
	11:00 a. m.	..	..	36	17	..	..	..	43	32	55.3
	11:30 a. m.	..	..	..	..	..	..	..	45	31	53.3
	5:30 p. m.	89	32	44	22	50.5	..	..	..	..	..
22	9:30 a. m.	83	50	30	16	64.0	89	70	41	30	54.0
23	11:00 a. m.	78	46	28	12	64.0	77	57	37	25	52.5
24	10:30 a. m.	84	47	34	20	62.3	90	62	43	43	48.0
25	12:00 n.	87	53	38	22	56.5	99	54	50	35	49.5
26	10:40 a. m.	72	38	25	16	65.3	74	74	38	28	48.8
27	2:00 p m.	66	39	17	11	71.2	67	67	36	26	53.8
28	2:00 p. m.	36	27	31.5	19	57.7	75	75	36	27	51.8
29	10:50 a. m.	64.5	41	26	12	59.7	64	64	27.5	22	57.0
30	11:15 a. m.	62	39	19.5	9	68.5	68	68	30	22	55.8
31	5:10 p. m.	65	39	19	13	70.8	65	65	30	22	54.0
Sep.											
1	5:00 p. m.	63	37	18	9	71.4	69	44	19	19	58.2
2	12:30 p. m.	84	50	31	16	63.2	86	56	40	28	53.5
3	5:15 p. m.	72	40	6.5	4	91.3	72	42	35.5	24	50.6
6	3:30 p. m.	69	33	20.5	15	70.6	70	28	36	23	48.7
7	11:55 a. m.	98	46	42.5	28	56.8	97	48	53.5	35	44.8
8	9:30 a. m.	89	47	32	22	64.0	91	48	43	30	52.8
9	10:25 a. m.	92	47	35	25	62.0	95	47	48	33	49.6
11	10:45 a. m.	70	42	20	16	71.8	72	78	34	27	52.6
12	9:50 a. m.	59	42	15	12	75.8	62	63	26.5	22	57.2
13	11:00 a. m.	60	43	15.5	13	74.3	60	68	22	18	63.3
14	10:15 a. m.	62	47	19	16	69.5	56	79	26	23	53.5
15	12:00 n.	64.5	43	17.5	14	72.8	65	80	27	23	58.3
16	11:10 a. m.	96	60	40	28	58.5	99	70	46	38	53.5
18	11:00 a. m.	44.5	25	9	8	80.0	46.5	36	18	16	61.3
19	3:00 p.m.	106	65	96	82	*	66	29	91	67	*
20	3:20 p. m.	40	26	11.5	10	71.3	42.5	41	19	17	55.5
21	2:00 p. m.	46	28	7.5	8	83.8	48	50	23	19	52.0
22	3:15 p. m.	83	64	33	27	60.5	86	80	39	34	54.6
23	11:20 a. m.	93	54	35	30	62.5	91	63	46	38	49.5
25	4:45 p. m.	106	64	47	38	55.5	106	68	57.5	44	45.7
26	11:15 a. m.	89	34	38	32	57.3	92	70	47.5	38	57.3
27	10:00 a. m.	49.5	30	11.5	10	77.0	48	55	24	20	50.0
28	12:45 p. m.	52.5	37	13	9	77.3	59	58	24.5	20	58.4

*Silica Gel Motor Drum Bearing burned out and had to be replaced. Unit shut down temporarily.

given off as the moisture condenses in the gel and thus raises the temperature of the air. This dried hot air then passes through the after-cooler where it is cooled to about 80 F. The after-cooler contains a finned water coil which utilizes the waste water from the main cooler to cool the treated air.

Activation of the spent gel is accomplished by passing hot gases of combustion plus considerable excess air through the gel, maintaining an inlet temperature of 300 F so as properly to activate the gel. The hot gases for activation are furnished by a small gas furnace and are sucked through the gel beds by the activation fan, which is mounted on the same shaft as the absorption fan so that both of these fans are driven by one motor from a V-belt drive. The moisture-laden gases leaving the gel beds are conveyed by a copper flue to the outside of the building. Of the twelve gel beds being activated, nine are being hot-gas-treated for moisture removal while the other three are being purged and cooled by having air sucked through them.

As the gel cylinder slowly revolves, one gel section comes to activation while one activated-and-purged section goes over to absorption again. By this means the absorption and activation is continuous with always twelve gel sections on absorption, nine sections on activation and three on purge.

The activation furnace consumes about 75 cu ft of 800 Btu gas per hour. The hot gases of combustion are "toned down" to a temperature of 300 F at the inlet of the gel cylinder by being diluted with excess air, which is taken in through an annular chamber surrounding the gas furnace. The amount of excess air is controlled by a damper in the flue close to the discharge outlet of the activation fan.

The circulating system consists of a circulating fan, a 4-section finned water coil cooler, a conditioned air delivery duct to the experimental ward and a return duct from the experimental ward back to the circulating fan. The dehumidified air from the gel unit mixes with the return air in a manifold on the suction line of the circulating fan. The latter picks up the mixed air (gel-treated air and return air) and forces it through the main cooler, then through the secondary filter and then up through the riser duct leading to the experimental ward. The riser enters the ward through the window sash about 8 ft above the floor. The return duct passes through a lower window sash about 3 ft from the floor.

Tap water is used in the main cooler. The discharge water from the main cooler feeds the after-cooler in the gel unit. The discharge water from the after-cooler goes directly to the sewer. The temperature of the tap water varied between 71 and 74 F. Cooling of the mixed air passing through the main cooler has been to within 1 or 2 F of the cold water inlet temperature.

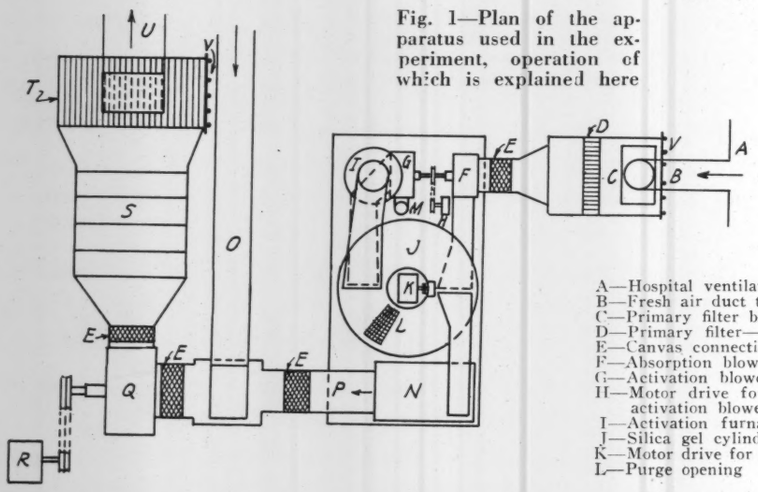


Fig. 1—Plan of the apparatus used in the experiment, operation of which is explained here

A—Hospital ventilation duct
B—Fresh air duct to gel unit
C—Primary filter box
D—Primary filter—vertical position
E—Canvas connections
F—Absorption blower
G—Activation blower
H—Motor drive for absorption and activation blowers
I—Activation furnace
J—Silica gel cylinder
K—Motor drive for gel cylinder
L—Purge opening
M—Flue pipe
N—After-cooler
O—Return duct from conditioned area
P—Conditioned air duct from gel unit to circulating fan
Q—Circulating fan motor drive
S—Finned water coil cooler
T—Secondary filter—horizontal position
U—Conditioned air duct to conditioned area
V—Access doors to filter boxes

Special Precautions with Filter Installation

Filtration is accomplished in two stages. The primary filter is located just ahead of the gel

unit and filters the fresh air obtained from the ventilating duct before it enters the gel unit. The filter box contains two 20″x20″ fluted filters in the vertical position. Each filter has a filtering area of 20 sq ft. The air velocity through the filters is 207 fpm. The filters are renewed every seven days.

Secondary filtration is accomplished by two 20″x20″ filters in the horizontal position. The air velocity through these filters is 285 ft. Special air tight doors are provided for accessibility to filter boxes.

Special precautions were taken in all construction work to make all joints as air tight as possible, because 100 per cent filtration of pollen was desired. Canvas connections were six ply and well shellacked. Duct joints were well soldered. All construction was made as rigidly as possible so as to eliminate noise.

Fresh air delivery to the gel units amounts to 1145 cfm. Conditioned air delivery to the ward amounts to 1405 cfm. With some allowance for leakage we can say that about 70 per cent of the conditioned air delivered to the ward is fresh air.

Table 2—Pollen Counts and Filtration Efficiency of Filtering Units—1933

Date		I	II	III	IV	VI	VII
Aug.	21	0	2	0	..	35	123
	22	0	1	4	3	..	73
	23	0	1	2	1	22	51
	24	4	2	1	1	65	297
	25	3	2	3	2	65	287
	26	0	7	2	7	55	242
	27	1	2	4	1	28	190
	28	4	5	2	0	17	54
	29	1	2	0	0	38	158
	30	1	2	0	1	105	228
	31	2	4	0	0	265	775
Sept.	1	1	2	2	0	571	850
	2	1	3	0	1	49	175
	3	4	3	1	0	140	289
	4	2	3	3	2	78	326
	5	2	4	0	1	210	718
	6	6	2	1	2	83	310
	7	1	4	0	1	108	487
	8	2	4	2	2	95	273
	9	7	3	4	1	21	57
	10	2	3	0	2	18	61
	11	0	3	0	0	33	133
	12	3	1	0	1	35	62
	13	0	0	0	0	18	170
	14	0	1	0	0	9	31
	15	0	0	0	0	18	67
	16	0	1	0	0	19	54
	17	1	1	0	0	9	43
	18	0	0	1	0	35	77
	19	0	0	0	0	27	40
	20	2	2	0	0	5	21
	21	3	0	0	0	21	185
	22	0	0	1	0	31	58
	23	0	0	0	0	..	..
	24	0	0	0	0	38	205
	25	0	0	0	0	7	38
	26	0	0	0	0	3	11
	27	0	0	0	0	3	13
		50	70	33	27	2379	7223

I and II = Settling count in the filtered air ward.
III and IV = Counts taken from intake ducts in filtered air ward.
VI = Settling counts in control ward.
VII = Settling counts out of doors.
Filtration efficiency in comparison to outdoor pollen counts — 99.17%.
Filtration efficiency in comparison to control room pollen counts—97.48%.

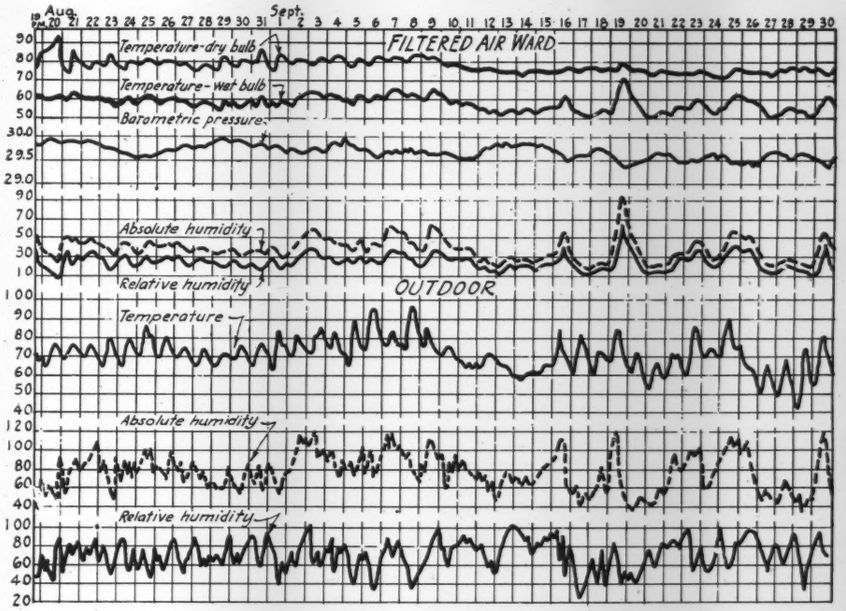


Fig. 2—Temperature, absolute humidity, relative humidity, and barometric pressure in the air conditioned ward and out-of-doors

Tables 1 and 2 and Fig. 2 show daily observations during the conduct of the experiment.

The absorption of moisture from the air by the silica gel depends on the original content of moisture. The higher the original moisture the lower the per cent absorbed by the gel as a function of the original amount.

Absolute humidity content in grains per lb of dry air of the fresh air to be treated	*Per cent of the absolute humidity removed by the silica gel*
60 grains	72.5%
70	70.0
80	63.0
90	60.0
100	57.0

Our experimental ward was maintained under a slight pressure in excess of atmospheric so leakage around windows and doors is outward. This prevents infiltration of outside air containing pollen. The ward had an air capacity of 7260 cu ft.

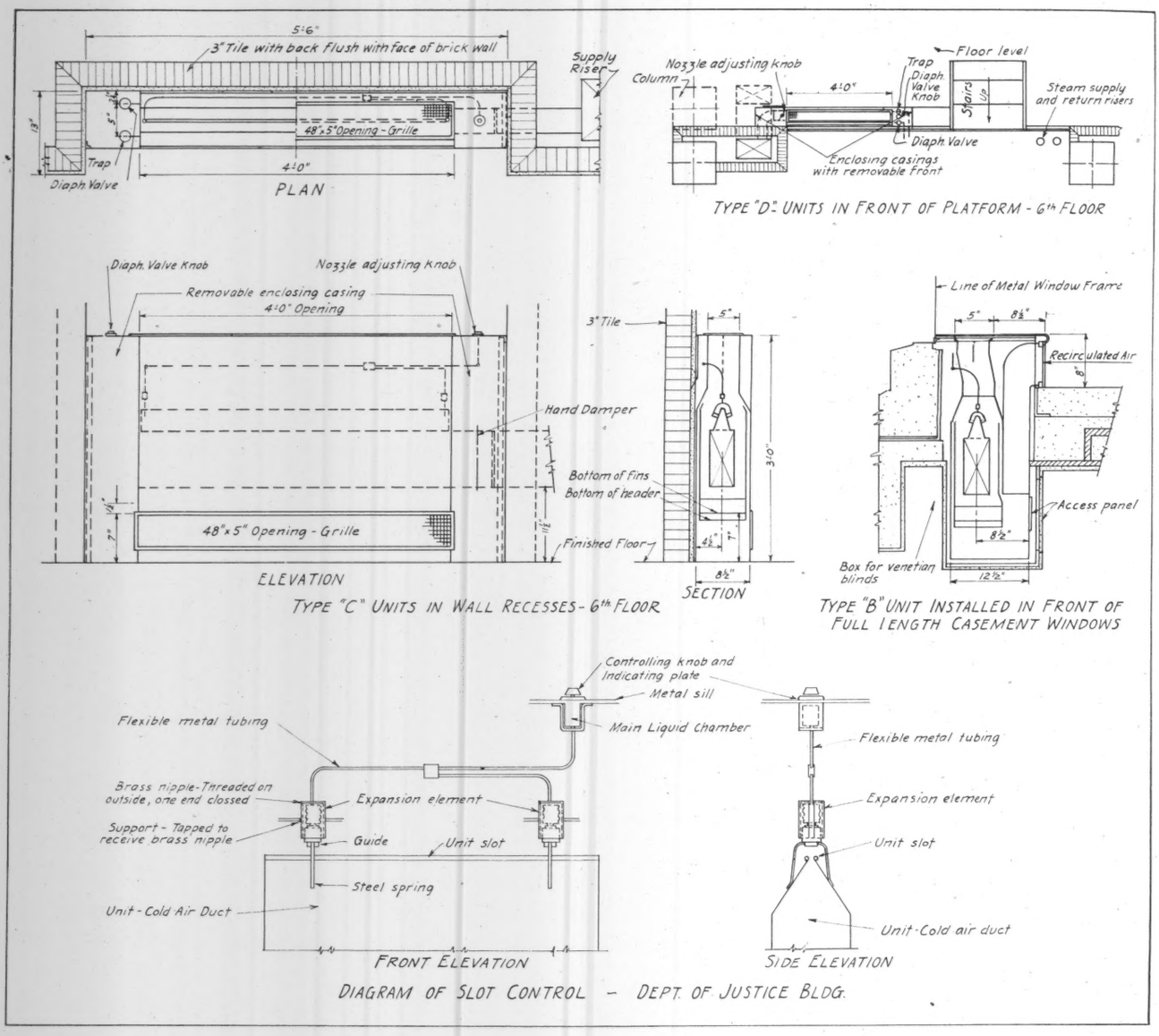
When 2200 cfm were delivered the air changes per hour amounted to 18.2. With an air delivery of 1505 cfm, 12.4 air changes per hour were obtained.

Results of the Experiments

Twenty-five patients with pollen asthma were confined in the ward from 5 to 31 days during the 1933 pollen season. As in our previous observations, patients with mild asthma were relieved in twenty-four hours, while those with very severe asthma required from 2 to 18 days for complete relief. However, with the low relative humidity and relatively constant temperature *the degree of relief obtained was greater and more prompt* than in our previous experiments.

It was also observed that several pollen asthma patients, who were symptom free, developed attacks of asthma while confined in the air conditioned ward shortly after a severe thunderstorm on September 4, 1933. Unlike the attacks which were precipitated under similar conditions in 1932, and which came on within an hour of the onset of the storm and were of severe degree, the attacks following the storm in 1933 came on from 6 to 8 hours later and were of a milder degree. The

(*Continued on page 345*)



By **J. McHollan***

Department of Justice

AIR CONDITIONS

its new building

FOR OFFICE EFFICIENCY

IN the design of any central air conditioning system, utilization of valuable space for the accommodation of large supply and return ducts is always a matter of great importance to the architects and to the owners. In the installation in the new Department of Justice building at Washington—now nearing completion—full advantage was taken of the design of the building so that not only was the minimum room space used for the ducts, but also they were located in positions that would least interfere with the architectural treatment of the rooms.

This was accomplished by running a cold air supply riser of relatively small size from the eighth floor down to the first floor alongside one column in each of the bays on all exposed walls on all floors. Each riser supplies air to the conditioning unit placed under the window on each floor immediately adjacent to the column. The risers are of course run in the column furring, and the run-out connections from the risers to the

*The Cooling & Air Conditioning Corporation, New York City.

units are concealed. In general this supply system of ductwork is very similar to a downfeed heating system.

Return air is taken into the corridors through louvres in the doors and carried back to the dehumidifiers through vertical return ducts located at several inconspicuous and unimportant locations.

Simplification of the ductwork was also made possible by the fact that all fans, dehumidifiers, dehumidifier pumps, heaters, and distributing duct mains are located in the eighth floor space, used solely to house the work of all mechanical trades. The sloping type of roof, characteristic of most government buildings in Washington, lends itself admirably to this arrangement.

Three Water-Cooling Units Have 1950-Ton Capacity

All occupied spaces throughout the entire building are air conditioned, the specified inside conditions being 80 F dry bulb and not over 50 per cent relative humidity under maximum outdoor conditions of 78 F wet bulb, irrespective of the outdoor dry bulb temperature.

The water cooling equipment, located in the basement, uses freon as the refrigerant. Three water-cooling units have been installed, each consisting essentially of one duplex, vertical, single acting type compressor direct-connected to an 80 per cent leading power factor synchronous motor, condenser and cooler, both of the latter being of the multi-pass shell and tube type. All the units are the same size and the total refrigeration effect for all three is 1950 tons.

The refrigerating equipment schedule is as follows:

COMPRESSORS

No. of Units	No. of Cylinders Per Unit	Cylinder Size: Bore	Cylinder Size: Stroke	RPM	Tons Per Unit
3	8	15″	11¾″	257	650

CONDENSERS

No. of Shells	Dia. of Shell	Length of Tubes	Sq Ft Effective Surface	Temp. Cond. Water	Water GPM	Total Tons Refrigeration
3	53″	20′0″	21,000	85°	5,800	1,950

COOLERS

No. of Shells	Dia. of Shell	Length of Tubes	Sq Ft Effective Surface	Water GPM	Final Water Temp.	Total Tons Refrigeration
3	55″	20′0″	18,000	6,300	49°	1,950

Water for condensing purposes was brought (under another contract) from the Potomac River Basin to a pit or well just outside the building. From this point it passes through a 20-in. duplex strainer to the condenser pumps, is forced through the condensers, and back to the River Basin again.

The chilled water pumps take water from the 16′0″ by 15′0″ by 12′0″ high, ⅜-in. thick galvanized steel plate storage tank located in the basement and pass it through the coolers to a 14-in. header in the compressor room.

PUMPS

	No. Pumps	Suction	Disch.	GPM Each	Total Head	Motor	RPM
Condenser Water	3	10″	8″	2,000	50′	30	1750
Chilled Water	3	8″	6″	2,100	175′	125	1750

From this header a separate connection is taken off for each of the nine dehumidifiers; this connection runs on the basement ceiling to a point where it rises vertically eight stories to the particular dehumidifier it serves. Valves in each of the connections near the header permit the operation of the other eight dehumidifiers in case of leakage in any one of the lines.

A valve operated by a water immersion thermostat governs the amount of chilled water fed into the dehumidifier pump suction, as is required to maintain the water in the dehumidifier at the proper temperature. The overflow water from the dehumidifiers is returned to the chilled water storage tank.

The nine separate dehumidifier units are located in various parts of the eighth floor, according to the sections of the building served. Each unit is complete with dehumidifier, dehumidifier pump, preheaters and reheaters, return air connection to both inlet and outlet of dehumidifier, fan and motor, and a complete system of automatic control.

For each of these nine systems, the dewpoint, fan discharge dry bulb, return air dry bulb, and return air wet bulb temperatures are recorded by electric resistance type thermometers. These temperature recorders are all mounted on a panel board located in the basement, in the compressor room. Recorders are also mounted on this board to show the following temperatures:

Water Discharge—Cooler No. 1
Water Discharge—Cooler No. 2
Water Discharge—Cooler No. 3
Chilled Water—Pump Suction
Water Discharge—Condenser No. 1
Water Discharge—Condenser No. 2
Water Discharge—Condenser No. 3
Condenser Water—Pump Suction
Outside Air Dry Bulb
Outside Air Wet Bulb

***ONE OF THE** largest installations of air conditioning in the country is nearing completion in the new Department of Justice Building, Washington, D. C., and will be placed in operation this summer. A refrigeration capacity of 1950 tons and a connected motor load of 3000 hp are required to completely condition this building, which is 525 ft long by 416 ft deep, eight stories high.*

Now handling an increased amount of work because of political and legal changes, the Department's personnel needs air conditioning's benefits. Weather conditions in Washington (as in most other cities) make air conditioning a practical necessity. Continued periods of high humidities during the summer produce a feeling of lassitude far from conducive to mental or physical efficiency.

Business — as well as government — executives are finding air conditioning a means of cutting office costs through increased efficiency, reducing lost time because of sickness, less mistakes. More difficult to evaluate than air conditioning for theaters, restaurants, stores, shops, etc., the advantages of air conditioning for office workers are fast becoming realized, as is evidenced by installations of the kind described here.

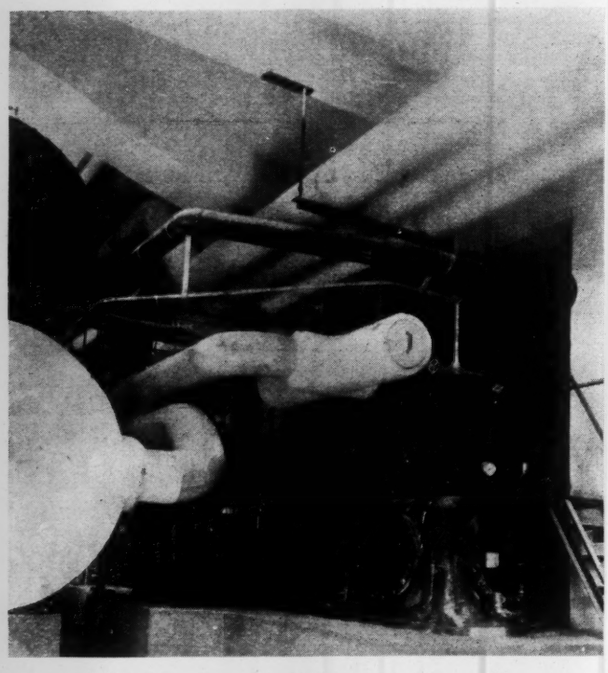
Delivery of Air to Rooms

The question of how the air should be delivered to a room in a ventilating or cooling system is a problem to which engineers have rightly given a great deal of consideration. It is important in a ventilating system, and becomes doubly so in a cooling system because of the greater differential between the temperature of the delivered air and the room temperature. Many systems have been severely criticized on this account—not for failure to properly consider this vital point, but because the method finally decided upon did not produce satisfactory results.

Of the complaints received from occupants of conditioned rooms, a few are purely imaginary, some are justified, and others are just a question of personal opinion. The engineer has to be a man of wondrous understanding to separate the wheat from the chaff. Witness the case, known to the writer, of two people working at the same desk, less than four feet apart, and subjected to the same temperature, humidity and air movement conditions. One complained he was too hot and the other complained he was too cold.

Also, the case of a telephone operator, one out of twelve girls working on a large switchboard. She continually complained of a draft which was not perceptible to her supervisor or to any of the other operators who sat in the complainant's chair. Moving her to other positions on the board produced no results. Apparently the draft followed her. Finally readings were taken which indicated that the temperature and humidity conditions in her immediate vicinity were the same as in any other part of the room, and that she was being subjected to an air movement of not over 30 fpm—which is a zephyr in any language.

Complaints like these will crop up no matter how carefully the system has been laid out or how much good judgment and experience the engineer puts into his design. They represent the "human element" which must be reckoned with in air conditioning. There is no question however that intelligent effort will reduce the justifiable complaints to a minimum, and under this heading comes uneven temperatures and drafts, as they are understood by the average healthy person.



Partial view of refrigeration unit with evaporator and condenser showing at left

Individual Control for Each Conditioning Unit

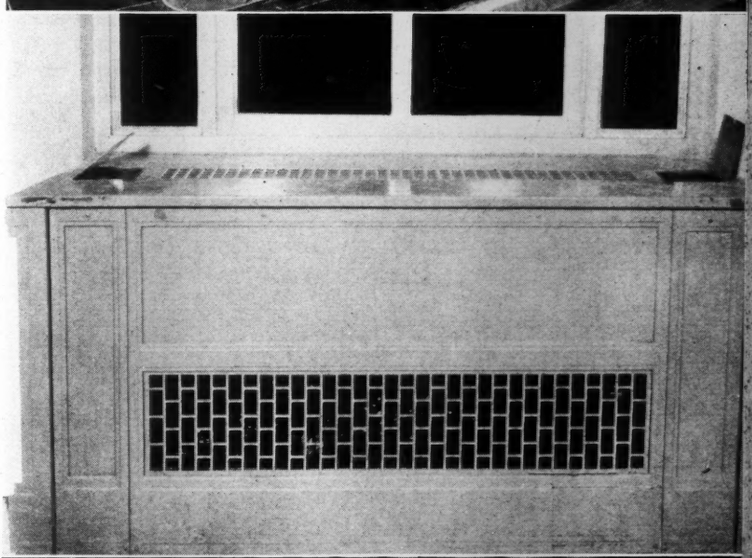
In the Department of Justice Building there is a large percentage of relatively small rooms and it seemed obvious that control by zones, risers, or exposure, would not satisfy the air movement and temperature requirements of so many individuals. A conditioning unit was therefore installed under each window in the occupied spaces, each with individual control. The selection of a reliable and effective mechanism for controlling the amount of cold air from the units was a difficult one. Many arrangements of gears, cams, linkages, etc., were worked up, tested out, and discarded for various reasons.

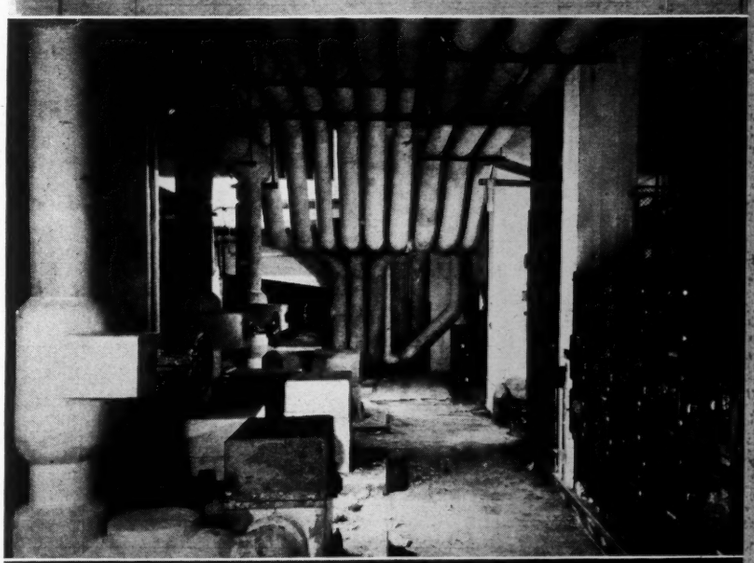
The slot or nozzle in the cold air duct of the unit through which the cold air passes is not over ½ in. wide and that much movement of the slot opening varies the amount of cold air delivered between zero and 100 per cent. It was apparent that only a microscopic movement of the nozzle blades would be necessary to accomplish a considerable reduction, in percentage, of cold air, and its corresponding effect on the temperature of the room. It also was obvious that the occupant could not be expected to spend much time making such minute adjustments. A control that required at least three or four turns of a knob or handle to move the slot from its closed position to its maximum opening seemed to be the most desirable form.

With this idea as a basis, a device was finally perfected which is simple, easy to operate, and which fulfills the desired requirements. The operation is as simple as tuning in a radio, and in reality is "finger-tip" control in a most reliable and effective form. This result was accomplished by the use of two expansion elements, of the sylphon bellows type. These are attached to the unit slot, one near each end, and connected by metal tubing to a liquid chamber on the under side of the unit enclosure sill. Both bellows and the liquid chamber are filled with a non-volatile liquid.

Turning a knob on the upper side of the sill forces the liquid from the chamber on the under side through the tubing and into the two expansion elements, which, as they expand, vary the width of the slot opening. Between five and six revolutions of the knob are required for the full movement of the nozzle, and as a result, very fine control of the delivered amount of cold air can be obtained. Total movement of the bellows is slightly over ½ in. and for commercial purposes, all were ordered for that amount of travel.

In many cases the required amount of cold air as determined by calculations called for a slot opening of less than ½ in. In such instances a hollow brass nipple, threaded on the outside and attached near each end of the slot, can be screwed in or out to limit the effective expansion of the bellows, as far as the slot is concerned, to an amount equal to the pre-determined width of the maximum slot opening.





FROM TOP TO BOTTOM—The new Department of Justice building in Washington, D. C., one of the largest single installations of air conditioning in the country (Architects: Zantzinger Borie & Medary, Philadelphia. Consulting Engineer: Isaac H. Francis, Philadelphia.) . . . . Typical window unit; in this style the knobs controlling the cold air supply and the steam for heating in winter are concealed in recesses below the sill. Flap covers of these recesses are shown open. . . . The next view shows (left to right) condenser pumps and piping; chilled water piping; and electric resistance type temperature recorders. . . . The bottom view shows one of the nine dehumidifier units

The slight pressure required to close the blades of the slot when the pressure on the bellows is released or reduced is furnished by two steel wire springs.

Altogether, 1526 window units were installed of which the "standard" type required for the unit enclosures in the window recesses comprises about 95 per cent of the total. This standard type was made in four different lengths to suit the various widths of the windows.

Problems in Installation of Units

In the installation of these units, several problems were encountered, one of which might be of interest.

In accordance with usual practice, the supply risers running down the columns were installed ahead of the outside walls and in many cases before the rough floors were poured. Before this work of installing the risers was begun, it was foreseen that there were several conditions which would necessitate more than the usual exactness in locating the risers and the taps for the run-outs between the risers and the units.

In the first place, before the finished floors were poured, it was necessary to install short duct connections from the risers over a point outside the furring so that the tile work could proceed. This brought the ends of the duct extensions a few inches from the collars on the units to which they were to connect after the finished floors were poured and the units set in place. The shortness of this final connecting piece left no leeway in either a horizontal or vertical direction.

To make it more interesting, the unit itself could not be moved either way in a horizontal direction due to the limitations of the metal enclosure in the front and the inside face of the building wall in the rear.

After the finished floors were poured and the units were set in their proper places it was found that in practically all cases the collars on the units lined up all right, horizontally, with the connections from the risers. A number of them however did not line up vertically because the top of the finished floors ran higher than expected in some cases and lower in others.

This condition was of course easily corrected, but at considerable expense. If this variation in the finished floors had been foreseen, it would have been a simple matter to make provision for it. Angle lugs could have been welded on to the ends of the unit near the bottom. One leg of these angle clips could be tapped and a bolt about 2 in. long inserted. The bolt half-way screwed down could be considered the normal position, and the location of all unit connections figured on that basis. Any variations in a vertical direction required to make the work fit could then be obtained by screwing the bolts up or down from their normal position.

MODERNIZE with STOKERS

IMPROVED heating, elimination of smoke, use of lower cost fuel, reduction in the tonnage of coal required and increased boiler plant capacity, are among the advantages which many plants and buildings have obtained by investing in automatic coal burning equipment. That the installation of stokers as a means of modernizing low pressure heating plants is a self

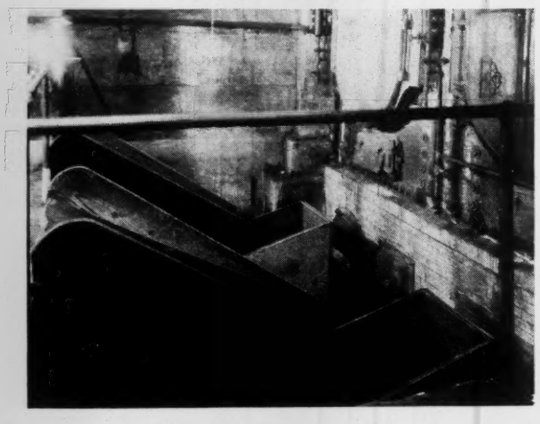


Fig. 1—This stoker installation saves 43 per cent in fuel cost as compared with hand-firing

liquidating and dividend paying proposition is amply proved by the records of hundreds of actual cases. It is our purpose here to report briefly on but a few of these cases as an indication to plant and building engineers of what may be effected by the use of well designed stokers, properly installed and intelligently operated.

Striking proof of the stoker as a heating-cost reducer is gained from an analysis of 160 commercial and industrial stoker installations in Cleveland, Milwaukee, and Toronto recently made by a stoker manufacturer and based on figures from the actual records of the various buildings. The average reduction in fuel cost for all installations—formerly fired by various means—was found to be 51 per cent, and the average annual return on the investment in stoker equipment 49 per cent. For 80 of the cases which had previously burned coal with hand-firing, the average reduction in fuel cost was 39 per cent, average return on investment 39 per cent, and average reduction in tonnage 23 per cent.

One of the installations included in this survey, an office building in Milwaukee, is shown in Fig. 1. In 1929, actual fuel cost, hand-fired, was $2,685.94. In 1930 this building changed to purchased steam, and for 1931—corrected to the 1929 basis—steam cost was $3,347.92. In 1933, the cost with stokers—also corrected to 1929 basis—was $1,532.89. It is seen stoker firing as compared with hand-firing saved 43 per cent. Labor cost was not increased with installation of the stokers.

A case where the stoker investment is practically paid off every year in the fuel savings made is that of the Monroe Building, Chicago (Fig. 2). In 1928-29, the last season without stokers, fuel costs ran 54.5 cents per thousand pounds of steam made, and the total fuel bill was $17,061. In 1929-30, during which period the second stoker was installed, fuel costs ran 45.6 cents per thousand pounds and this differential made a saving in that year of $3,000. In 1930-31, fuel costs ran 37.4 cents per thousand pounds of steam, giving a saving of $5,775; in 1931-32, fuel cost was 36.2 cents per thousand pounds, a saving of $5,570. For 1932-33, fuel cost equaled 33.65 cents per thousand pounds, saving $6,775.

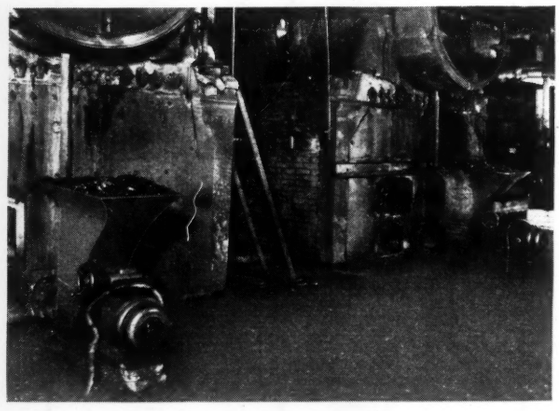


Fig. 2—The investment for these stokers is practically paid off every year in the savings they make

For the 1933-34 season, fuel cost was 33.2c per 1000 lb of steam even though the price of coal was about ten per cent higher. This indicates a saving of $6,850 over the previous hand-fired practice. Electric energy required to operate the stokers during this five-year period was $2,250 leaving a net saving of $25,720 before depreciation, interest and maintenance, all of which were "very nominal." To produce the above saving required an investment of only $5,500 for the two stokers, flow meters, etc. The figures are reported by R. E. Hieronymus, general superintendent, Aldis & Company, the owners.

A multi-occupancy loft building of the Alexander

to Cut Cost, Improve Service, Eliminate Smoke

Bauer Estate, also in Chicago, provides convincing data. Cost of fuel in 1932-33 with hand-firing using Pocahontas was $1,350, according to the records of John Bergen, Chief Engineer of the Estate. After installation of the stoker, Fig. 3, the cost of fuel (Franklin County screenings) for the season of 1933-34 was $930. The saving is due both to lower cost of the stoker fuel and reduced tonnage required. Degree days for 1932-33 were 6,087, for 1933-34 6,091. In addition to reducing cost of fuel, the stoker installation gave more even heating of the seven-story building and aided smoke prevention.

The stokers at Elgin Academy, Elgin, Ill., are shown in Fig. 4. This installation was made in order to eliminate smoke nuisance, says Dean Karl J. Stouffer, and this has been accomplished successfully; in addition, more even heating has been obtained "with perhaps a little saving" in the cost of coal required.

Yet another case is that of a large office building the heating system of which was revamped at a cost of $20,000 in the winter of 1930-31 in order to render the tenants better heating service; this work cut the cost of the steam requirements from $7,700 to $5,400, or about 30 per cent. Then in 1932 this building was equipped with boilers already owned, and stokers were put in them, the cost being around $6,000. As a result, the cost of heating for the following winter dropped to $3,200 or 42 per cent below the cost of heating *after the plant had been modernized*. The total saving due to the original modernization and the installation of the stokers was $4,500 or about 62 per cent from the cost of operating the system originally.

Not only can stokers reduce operating costs, but frequently an investment in them can obviate a much larger investment where greater plant capacity is required by a new building, an addition to a building, etc. A large educational institution called in a consulting engineer for advice as to how its central boiler plant could be enlarged to provide for additional buildings. His survey showed that the boilers (2,800 hp) were operating at 51 per cent efficiency and below normal rating. At relatively small cost, stokers and other equipment were installed, efficiency of the boilers was maintained above 70 per cent, and ample capacity made available for the additional buildings. An investment of $80,000 proposed was unnecessary and the new buildings were heated without any additional fuel cost.

A similar situation came up at the St. Francis Hospital, Evanston, Ill., when a wing was added which increased the heating load by about one-third. At the same time the two stokers shown in Fig. 5 were installed and the average annual coal requirement remained approximately 2000 tons the new addition to the building being heated with no more cost for fuel.

A previous article by Samuel R. Lewis, Consulting Engineer, summarized the experience with the Cherry-

Fig. 3—Cutting the annual cost for fuel to $930 from $1,350, better service for the tenants, no trouble from smoke, are among the advantages of this installation

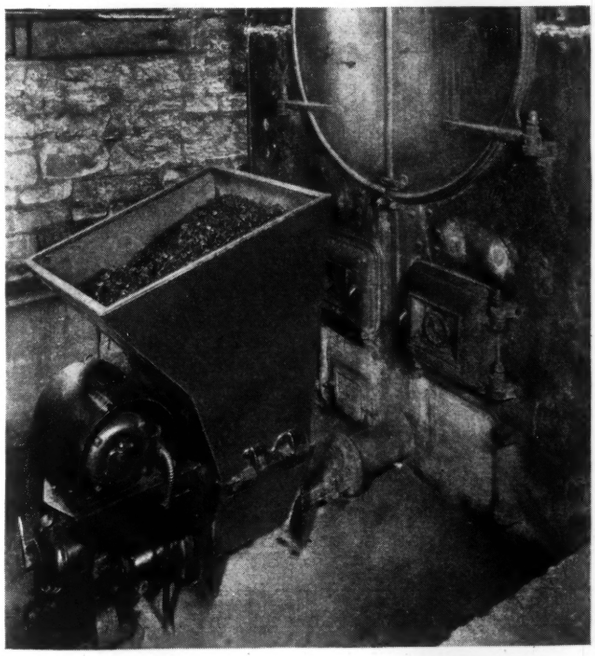
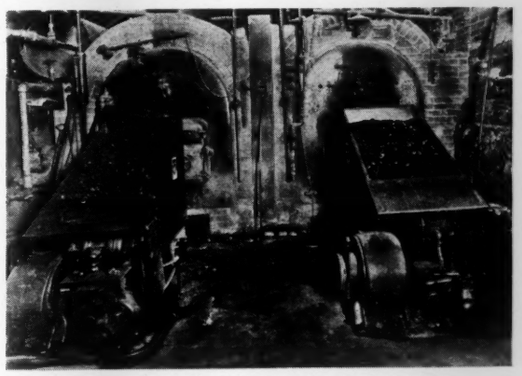


Fig. 4—Installed to prevent smoke, these stokers accomplish their purpose, also give more even heating and a saving in coal



Feilbach school group in Toledo. The Cherry school was built way back in 1914. It had two 66-in. by 16-ft, 0-in. horizontal tubular boilers of the best type of construction, with high settings and with hand-fired grates provided with special high-temperature smoke-consuming arches and steam jet draft inducers recommended at

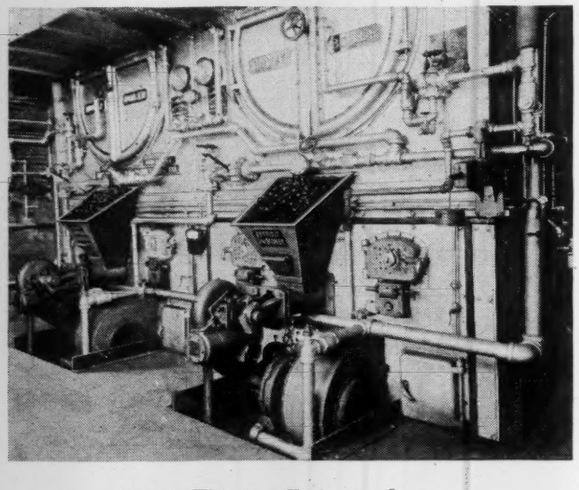


Fig. 5—This installation made possible the heating of an addition to the building at no extra cost

that time by the Chicago smoke prevention department. This scheme was not satisfactory as a smoke consumer, and for years Pocahontas coal has been burned in the Cherry School as a matter of smoke abatement. The boilers were somewhat over-size, beyond normal rating, to allow for a possible future addition. In 1930 this addition finally was made, but it became the Feilbach school, a separate building on the same plot, requiring nearly as much steam as did the Cherry school.

The boiler problem was met by installing modern forced-draft underfeed stokers (Fig. 6) under the old boilers in the Cherry school, and by proportioning these stokers for developing up to 145 per cent of the boiler rating. The whole situation is one which especially is favorable to such a project and the results prove ample justification and point to the stokers as an excellent investment.

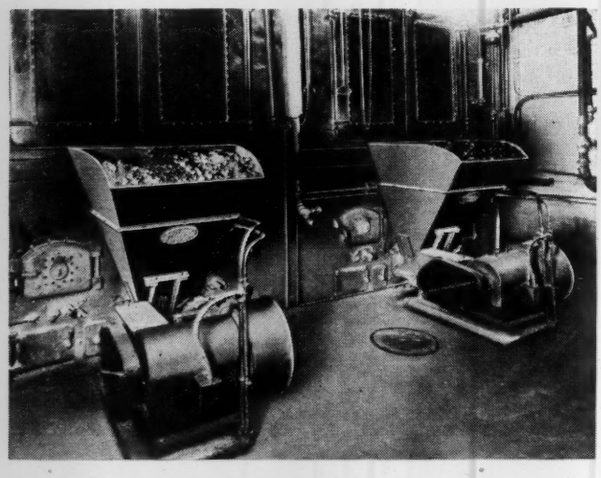


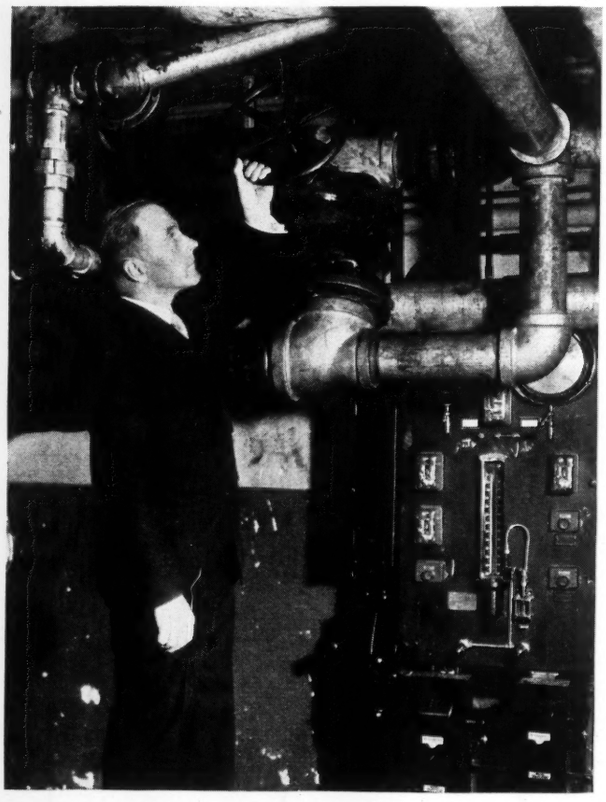
Fig. 6—These stokers save 75c per 1000 cu ft in heating the original school in which they are installed and in addition provide increased capacity for heating an entire new building, saving a heavy capital expenditure

Fuel Report 1930-31, old building only, 270 tons semi-anthracite at $4.74, $1,279.80. Building contents 910,000 cu ft. Annual cost of fuel per 1,000 cu ft of space heated, $1.40.

Fuel report 1931-32, Cherry plus Feilbach, 338 tons screenings at $3.19, $1,078.22. Building contents 1,660,500 cu ft. Annual cost of fuel per 1,000 cu ft of space heated, 64.9c.

The stokers thus brought about a saving of 75 cents per 1,000 cu ft, amounting to $682.50 per year for the Cherry school alone, to say nothing of the saving of the heavy capital investment which otherwise would have been necessary for a chimney, a boiler room, a fuel room and a boiler plant in the Feilbach school. The stokers have, in addition, eliminated the complaints formerly made of smoke from the hand-fired furnaces.

[Acknowledgement is made to those who have furnished the figures quoted in this article and to the Detroit Stoker Company, Econocol Stoker Company, Iron Fireman Mfg. Co., Link-Belt Company, and Modern Coal Burner Company for furnishing leads to installations, photos, etc.]



"With Air Conditioning, Sir?" Says Room Clerk at Detroit Statler Hotel

The latest development in hotel comfort was announced last month by Frank A. McKowne (see cut), president of the Statler Hotels Company, when the Detroit Statler placed in operation the 167-ton steam jet refrigeration system which supplies water at 47 F for air conditioning a number of guest rooms, in addition to various public spaces. In a sense a "trial" installation, it is expected later to air condition more guest rooms in the Detroit hotel and in other Statler hotels.

Lowest priced air conditioned room is $4.00, single occupancy; also in the air conditioned group are rooms priced up to $9.00, single occupancy. Lowest priced non-conditioned rooms are $2.50.

Requirements for

Welded Piping Joints

. . . . . as given in the proposed American Standards Association *Code for Pressure Piping are quoted here; in the July issue the Code's chapter on welding was explained and discussed. The author gives this part of the Code detailed treatment because of the importance of welded joints in present day piping systems.*

By . . . . **Sabin Crocker***

IMPORTANCE of welded joints in present day piping systems has made it advisable to treat in some detail Chapter 3 of Section 5 on fabrication details in the Proposed Code for Pressure Piping, which covers the welding of pipe joints. In the author's article last month, welding as covered by the Code was explained and discussed, and in the present article the Code material is quoted:

Classification. This chapter concerns the welding of piping joints by the fusion process and relates to such joints as are formed by (1) pipe end to end, (2) pipe branches, (3) pipe to flanges, fittings, and valves, and (4) pipe, valve, or fitting, etc. (not part of apparatus) to other equipment. It is not intended to deal with the design of special fabricated pipe fittings, but it does pertain to the fusion welds made in the fabrication and joining of such fittings. The general phase of this chapter is subject to accompanying Code limitations regarding pressure, temperature, and fluid carried.

Definitions. (a) For convenience, the definitions of some of the more common terms have been included herein, and their specific applications under this Code are defined as follows:

(b) FORGE WELDING. (1) The process of joining metal parts in the plastic state with the application of pressure developed by manual or mechanical hammer blows or by rolling.

(2) Under this Code, forge welding includes blacksmith welding, hammer welding, and roll welding.

(c) PRESSURE WELDING. (1) The process of joining metal parts in the highly plastic and/or molten states with the application of mechanical pressure.

(2) Under this Code pressure welding includes thermit pressure welding, resistance welding, and flash welding.

(d) FUSION WELDING. (1) The process of joining metal parts in the molten, or molten and vapor states, without the application of mechanical pressure or blows.

(2) Under this Code fusion welding includes gas welding and arc welding.

(e) STRENGTH WELD. A weld designed to have a pre-determined strength and primarily intended to secure a mechanically strong joint. The weld may be continuous or intermittent.

(f) SEAL WELD. A continuous arc or gas weld primarily intended to secure tightness.

(g) ROOT. The zone at the bottom of the cross-sectional space provided to contain a fusion weld.

(h) THROAT. (1) The minimum thickness of a weld, not including reinforcing, along a straight line passing through the root.

(2) The throat of a butt weld shall be at least equal to the thickness of the thinner part joined.

(i) FILLET WELD. (1) A weld of approximately triangular cross section, whose throat lies in a plane disposed approximately 45 deg with respect to the surface of the parts joined.

(2) The size of a fillet weld shall be expressed in terms of the width in inches of one of its adjacent fused legs (the shorter if unequal). See Fig. 3.

(j) BUTT WELD. (1) A weld whose throat lies in a plane disposed approximately 90 deg with respect to the surfaces of at least one of the parts joined.

(2) The size of a butt weld shall be expressed in terms of its net or unreinforced throat dimensions in inches.

(3) A double welded butt joint is one in which the filler metal is added to both sides (see Fig. 2). A single welded butt joint is one in which the filler metal is added to only one side (see Fig. 1).

(k) GAS CUTTING. The process of severing metal by means of a gas flame.

Materials. (a) The materials for pipe, fittings, valves, and flanges shall conform to the requirements of the various sections of this Code.

(b) Material to be welded shall be of a good weldable quality, free from laminations and other harmful ingredients or defects.

(c) The filler metal, electrodes, welding wire and/or welding rods when used shall be suitable for use with the base metals to be welded, to produce sound welds as defined by this Code.

Design of Fusion Welded Joints. (a) The preparation of parts for fusion welded joints shall be approximately as shown in Figs. 1 to 4 inclusive. Welds shall be either of the butt or fillet type, or combinations of same, designed as shown and described herein.

(b) BUTT WELDS. Butt welds may be of either the single "V" (Fig. 1) or double "V" (Fig. 2) type. The edges of the parts to be joined shall be beveled and spaced where necessary, and the welding procedure shall be such as to insure complete penetration of the deposited metal to the bottom of the joint and thorough fusion of the deposited metal with the base metal. Ferrules or backing strips inside the pipe may be used if properly secured and thoroughly fused to the weld. Care shall be used not to burn through the ferrule or backing strip. Butt welds shall be reinforced not less than $\frac{1}{16}$ in. for material up to and including $\frac{1}{2}$ in. thick and $\frac{1}{8}$ in. for material over $\frac{1}{2}$ in. thick. These thicknesses refer to the thinner parts joined.

(c) Welds shall have no depressions at the edges below the

*Engineer, The Detroit Edison Company, and Member of Board of Consulting and Contributing Editors. Among other standardization committee affiliations, Mr. Crocker is Chairman of Subcommittee I on Plan, Scope, and Editing of *A. S. A.* Sectional Committee B 31 on Code for Pressure Piping.

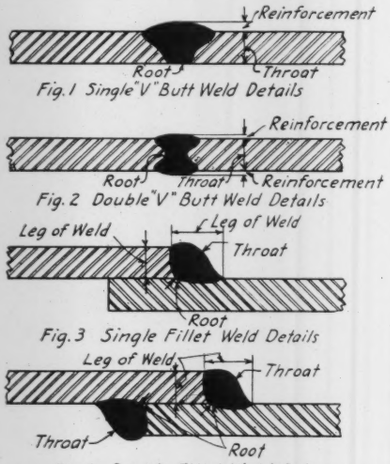


Fig. 1 Single "V" Butt Weld Details

Fig. 2 Double "V" Butt Weld Details

Fig. 3 Single Fillet Weld Details

Fig. 4 Double Fillet Weld Details

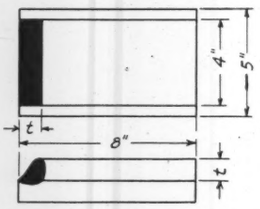


Fig. 5 Fillet Weld Test Specimen

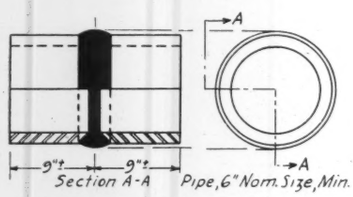


Fig. 6 Butt Weld Test Specimen

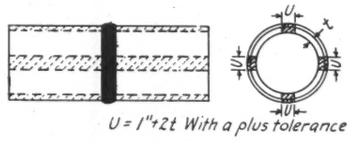


Fig. 7 Selection of Weld Test Bars (shaded portions) To Be Cut From Butt Weld Specimen of Fig. 6

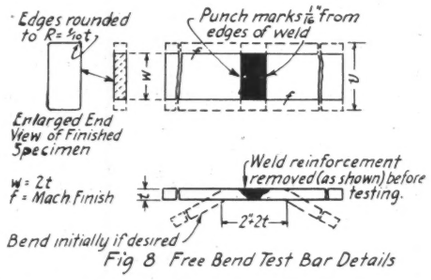


Fig. 8 Free Bend Test Bar Details

surfaces of the parts joined, and shall be so built up that there is a gradual increase in thickness from edge to center.

(d) Fillet Welds. Fillet welds may be either of the single (Fig. 3) or double (Fig. 4) fillet type, and the welding procedure shall be such as to insure complete penetration and thorough fusion of the deposited metal with the base metal. No fillet weld shall have a throat less than 0.75 times the nominal size of the weld.

(e) Seal Welds. (1) Seal welds shall not be considered as contributing to the strength of joints.

(2) Seal welds may be of either butt or fillet type and should be made as small in cross section as practicable, to insure tightness and minimize heating of the parts sealed.

(3) When applied to pipe joints where strength is supplied by other parts, the seal welding must be done so as to avoid undue straining of the joint structure due to temperature changes.

(4) When applied to riveted and similar joints, the tightness of the riveting or other fastening shall be checked before and after seal welding. Seal welding shall not be applied to tighten loose rivets or other fastenings.

(f) Cast Iron and Nonferrous Materials. (1) Where the welding of cast iron flanges, fittings and pipe is permitted, they shall be welded with bronze or other suitable filler metal.

(2) Copper pipe shall not be welded with copper welding rod. It may be welded with bronze welding rod.

(3) Brass pipe may be welded with bronze welding rod.

Welding Flanges and Fittings. (a) Flanges, fittings, valves, or other piping equipment may be provided with welding ends suitable for welding directly into a pipe line, but their design must be such that no damage will result from the welding or stress relieving operation so as to render the equipment useless or unsafe for service.

(b) Welding Flanges. (1) The design of welds for steel flange connections may be as shown in Fig. 11, or of other suitable welding design, provided complete penetration and thorough fusion of the deposited metal has been made with the base metal and that the component parts of the joint meet the pressure and service requirements of the system.

(2) Where attachment of cast iron flanges to pipes is permitted, bronze or other suitable filler rod shall be used.

(c) Special Fittings. (1) Tees, bends, branch connections, swages and other fittings may be formed from pipe or fabricated from plate material and welded. Fabricated fittings shall be prepared so as to permit thorough penetration of the weld to the bottom of the joint and all welds shall be made in conformance to the general requirements of welded joints specified in this Section.

(2) Special fittings with welding ends may be welded directly into a pipe line in conformance to the general requirements of welded joints specified in this section provided their materials and wall thicknesses for the service conditions contemplated are in agreement with such as set forth in that particular piping system section of this Code. (This requisite applies as well to valves with welding ends.)

Welding Procedure. *(a)* Beveling shall preferably be by machine, but may be done with the torch if the surfaces are thoroughly cleaned from scale and oxidation afterward.

(b) Surfaces for butt and fillet welding shall be thoroughly cleaned and shall be free from paint, oil, rust or scale before welding, except that a light coat of linseed oil used to preserve the beveled surfaces from rust may be permitted.

(c) Before welding, the piping or other equipment shall be carefully lined up so that no part is offset with respect to the adjacent part by more than 20 per cent of the pipe thickness. This alignment must be preserved during welding.

(d) The length of tack welds shall be approximately twice the thickness of the thinner material joined. Tack welds shall be kept below the outside surface and shall be melted out during welding.

(e) All welds shall be of sound metal thoroughly fused to the base metal.

(f) No globules of weld metal shall project within the pipe so as to seriously restrict its area or cause danger of loosening and falling into the pipe.

(g) All butt welds shall be reinforced as specified in Par. (b) under *Design of Fusion Welded Joints*. The thickness of reinforcement shall gradually increase from the edges to the center. Exposed surfaces of reinforcements shall be free from depressions below the surface of the pipe.

(h) Nozzles, tees, and branches in materials ¾ in. or more in wall thickness shall be welded under shop or equivalent conditions.

(i) When welding a connection, bracket or part, or making repairs by welding, on any valve, controlling fixture, sliding expansion joint, or other equipment, the welding heat might cause distortion of the valve seat, slide guide, or other operating part according to the proximity of such part to the weld. It is therefore imperative that when performing such work it shall be ascertained whether the equipment should be removed from the lines and/or be dismantled or to provide proper protection to prevent damage to the working parts. After the work has been completed, a test shall be made to prove that the working parts are functioning properly before putting the equipment into service.

(j) When repairing defects in forged or cast steel flanged valves or fittings, or seal welding joints in flanges in place, it is recommended that the flange bolts be loosened enough to

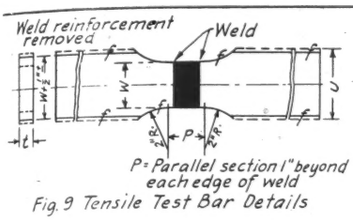


Fig. 9 Tensile Test Bar Details

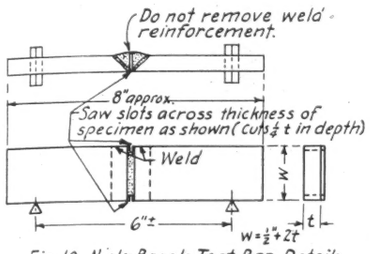


Fig. 10 Nick-Break Test Bar Details

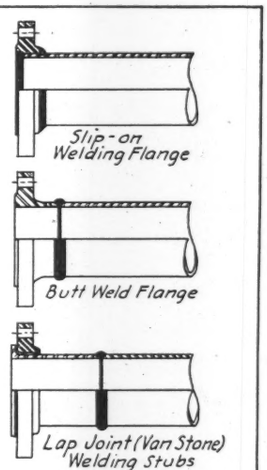


Fig. 11 Typical Details for Welding Flanges and Lap Joint Welding Stubs

prevent expansion strains from affecting the welds or bolts. Where desired, temporary erection bolts may be used during welding.

(k) Stress Relieving. (1) Welded joints in carbon steel piping shall be stress relieved by one of the methods described in this section when the pipe wall thickness is ¾ in. or more and the service temperature is greater than 250 F.

(2) Stress relieving shall be done by heating uniformly to a temperature of between 1100 and 1200 F. The parts heated shall be brought slowly to the required temperature and held there for a period in the ratio of one hour per in. of thickness and shall be allowed to cool slowly in the atmosphere.

(3) Heating shall be by one of the following methods:

(a) Heating the complete structure as a unit.

(b) Heating a complete section containing the weld or welds to be stress relieved before attachment to other sections of work.

(c) Heating a part of the work by heating uniformly a circumferential band having a minimum width of 6 times the plate thickness on each side beyond the welds to be stress relieved in such a manner that the entire band shall be brought up to temperature uniformly and held for the time specified above.

(l) Identification. After completing a welded joint the welder shall stamp it with a number or mark to identify it as his work.

Testing. *(a)* All welded piping work shall be inspected for general excellence of workmanship in addition to the pressure tests specified. If there is a reasonable doubt of the satisfactory quality of a weld, it may be checked by trepanning out a coupon large enough to show a clear cross section of the weld. This coupon shall be ground smooth at both sections of the weld and deeply etched for examination. Both etched sections of the weld shall pass the examination required for the fractured surfaces of the weld in nickbreak test specimens described in Par. (e 5) under *Tests*. If the weld proves satisfactory, the hole should be closed by welding-in a steel plug or other suitable piece of material, care being taken to minimize strains due to heating.

(b) In small diameter piping and where conditions render trepanning undesirable, the quality of work may be checked by the removal of a section of pipe containing the weld and large enough to permit proper inspection by smooth grinding and etching.

(c) Hydrostatic Tests. (1) Piping and associated equipment fabricated with welded joints shall be capable of withstanding hydrostatic shell tests as specified in the Section of this Code covering the class of service required.

(2) Piping for 25 lb steam service pressure (S.S.P.) may be tested with air or water at 50 lb gage.

(3) Preliminary test with air at 100 lb gage may be made using soapy water to detect leaks, except for piping where the test pressure is less than 100 lb.

(4) During hydrostatic pressure tests the welds shall be hammered by striking sharp, vibratory blows on the material on alternate sides of the weld and close to it. The blows shall be hard enough to jar the weld without seriously denting the material.

(5) Seal welding may be tested by any fluid convenient, preferably under the conditions of service, and at service pressure. Inflammable gases or liquids may be used only under the conditions specified in the section of this Code covering the class of service required.

Acceptance and Rejection. *(a)* In all work pin-hole leaks may be repaired by welding, but special care shall be taken to prevent local stress concentration due to heating and cooling.

(b) Seal welds showing defects may be rewelded. Where the defect is of considerable extent the defective weld metal should be chipped out so as to keep the cross section of the finished weld small.

(c) General sweating of any weld is cause for its rejection and complete removal and rewelding.

(d) If inspection of a weld, as specified in Pars. (a) and (b) under *Testing* should show failure to meet the tests it shall be cause for rejection of the weld tested.

(e) A second failure of a weld made by a welder whose work has already failed on test once, shall be cause for the check of all welds made by this welder and for his suspension until he can show proof that his work fully meets the requirements for uniformly satisfactory welds.

Workmanship. *(a)* Each employer shall be responsible for the quality of the welding done by his organization and shall conduct tests of the welders to determine their ability to produce welds that will meet the requirements.

(b) The tests of a welder shall be effective for a period of six months only and the tests given by one employer shall not qualify a welder to work for another employer. The employer shall maintain a permanent record of the welders employed by him, showing the dates of employment, the dates and results of tests and the identification mark assigned to each welder. These records shall be certified to by the employer and shall be accessible for inspection.

(c) No welding shall be done on any piping, fittings or associated equipment except by welders who have demonstrated their competency by tests as required herein.

(d) The tests specified shall apply to both field and shop welding except where special conditions such as machine welding may make them inapplicable. For these special conditions, plates of steel of the same quality and thickness as the work to be done may be substituted for the pipe specimens called for. These plate specimens shall be welded similarly to the work to be done and shall be tested as specified for the class of service. In all cases, the term "similar quality" is to be considered as meaning of similar chemical and physical characteristics. When welding test specimens, the welding procedure, welding wire or rods, and type of equipment shall be the same as for the work to be done.

Qualification Tests for Welders. Welders for strength welds on piping for all liquids, vapors, and gases shall pass the tests indicated in the table (next page) before being allowed to start work. Welders who satisfactorily pass the higher class tests (Test *e* for conditions where work may be turned during welding or Test *f* where work may not be turned during welding) shall not be required to take the lower class tests in addition.

Tests. Test *(a)*. (1) The welder shall make two or more fillet weld test specimens as shown in Fig. 5, which shall be made in the flat position. The specimens shall be prepared from plate of the same general quality and thickness as the pipe to be welded. The specimens shall be prepared, cleaned, and welded in the same way as for piping.

Qualification Tests for Welders for Strength Welds

Fluid	Liquids				Vapors and Gases			
Service Characteristics	Below boiling point at atmospheric pressure but not in excess of 150 F		Above boiling point at atmospheric pressure or below boiling point but in excess of 150 F		At 150 F or below		Above 150 F	
Service Pressure in lb per sq in. gage	250 or below	Above 250	125 or below	Above 125	250 or below	Above 250	125 or below	Above 125
	Tests	Tests	Tests	Tests	Tests	Tests	Tests	Tests
Where work may be turned during welding	*a* and *c*	*e*	*a* and *c*	*e*	*a* and *c*	*e*	*a* and *c*	*e*
Where work may not be turned during welding	*b* and *d*	*f*	*b* and *d*	*f*	*b* and *d*	*f*	*b* and *d*	*f*

(2) After cooling, the specimens shall be torn apart by driving a suitable wedge into the end opposite the weld and bending the plates at the weld till fracture occurs.

(3) The fracture shall show the following characteristics:

Penetration of the weld to the inner corner of the joint. Thorough fusion of the weld to the base metal. Fracture shall be clean and dense, free from iridescent colors and of fine, even crystalline or fibrous structure, clean metal, substantially free from gas pockets, cold shuts, or slag inclusions. The sum of all the above faults present shall not exceed eight gas pockets or equivalent per sq in. of area of the fracture. The maximum dimension of any such defect shall not exceed $\frac{1}{16}$ in.

Test *(b)*. (1) This test shall be made exactly like Test (a), but the specimens shall be welded in the horizontal overhead position.

(2) The specimens shall be fractured and examined as in Test (a).

Test *(c)*. (1) The welder shall make one or more butt-weld test specimens as shown in Fig. 6, which shall be made in the flat position, rotating the work as the weld progresses. The specimens shall be made from pipe of the same general quality and size as the pipe to be welded, but in no case less than 6 in. nominal size. The specimens shall consist of two pieces of pipe approximately 9 in. long and shall be prepared, cleaned, and welded in the same way as for the proposed work.

(2) After cooling of the finished specimen, four longitudinal test bars shall be cut (gas cutting permitted) spaced approximately uniformly around the specimen and located so that one bar shall contain the finishing point of the weld. The bars shall have a width of approximately 1 in. plus twice the bar thickness, each containing a portion of the weld in the center. Before testing, the reinforcement of the weld must be removed, making the welded surface flush with the surface of the base metal, and the specimen machined or ground to a width equal to twice the thickness and the corners rounded to a radius of 1/10 the thickness.

(3) These test bars shall be tested by bending under pressure in a vise or compression machine or other device producing a gradual, uniform bending across the weld.

(4) Two of the bars shall be bent so that the outside of the weld is on the convex surface. The surface of the weld shall show an elongation of 15 per cent without cracking (cracks less than $\frac{1}{16}$ in. long excluded).

(5) Elongation shall be measured between gage marks set in the weld metal as near as possible to the edge of the weld on each side.

(6) Two test bars shall be bent so that the inside of the pipe is on the convex surface. These bars shall not break apart when bent 90 deg. Elongation should not be measured on these bars.

(7) After the above tests, the test bars shall be nicked and bent back and forth until broken in the weld, and the fracture shall be examined and shall possess the characteristics required under Test (a).

Test *(d)*. (1) This test shall be made exactly like Test (c), but the specimen shall be welded in the fixed horizontal position. The specimens shall be examined and shall possess the characteristics specified for Test (c).

(2) The test bars from the horizontal specimen or specimens shall be cut from the top, bottom, and sides spaced uniformly around the specimen.

Test *(e)*. (1) This test shall be made from two or more specimens prepared as specified for Test (c).

(2) After cooling of the finished specimens, four longitudinal test bars shall be cut from each (gas cutting permitted), as shown in Fig. 7. Two of these bars from each specimen shall be prepared for the free bend test as shown in Fig. 8, one from each specimen shall be prepared for the reduced section tensile test as shown in Fig. 9, and one from each specimen shall be prepared for the nick-break test as shown in Fig. 10.

(3) The reduced section tensile test bars shall be pulled in a suitable testing machine and each shall show an ultimate strength of not less than 90 per cent of the minimum specified for the material of the pipe.

(4) One of each pair of bend test bars shall be bent so that the outside of the weld is on the convex surface. It shall show an elongation of not less than 15 per cent without cracking (cracks less than $\frac{1}{16}$ in. long excluded). The second bend test bar of each pair shall be bent so that the inside of the pipe is on the convex surface. The bar shall not break apart when bent 90 deg.

(5) The nick-break test bars shall be broken by a sudden blow or blows applied at the center of the weld, which should be of sufficient intensity to cause a sharp, sudden fracture of the bar through the nicked portion. The fractured surfaces of the weld shall show complete penetration through the entire thickness of the weld, absence of oxide or slag inclusions, and degree of porosity not to exceed six gas pockets per sq in. of the total area of the weld surface exposed in the fracture, the maximum dimension of any such pocket not to be in excess of $\frac{1}{16}$ in.

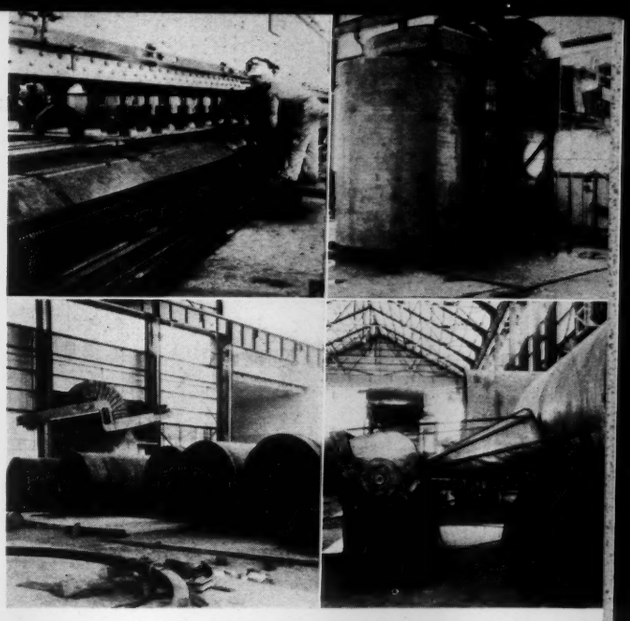
Test *(f)*. (1) This test shall be made exactly like Test (e), but the specimens shall be welded in the fixed horizontal, or in the vertical position, or one in each position. If the work to be welded is entirely horizontal or vertical, both specimens shall be welded either horizontally or vertically respectively; if both classes of work are contemplated, one specimen shall be welded horizontally and one vertically. The specimens shall be examined and shall possess the characteristics specified for Test (e).

(2) The test bars selected from the specimen shall be tested as follows: When the test specimen has been weldd in the fixed horizontal position, the back bend test shall be made on the bar selected from the top of the specimen so as to include the finishing point of the circumferential weld. In the case of the specimen having been welded in a fixed vertical position, this back-bend test bar shall be selected from that part of the specimen containing the finishing point of the circumferential weld. The free bend test shall be made on a bar selected from the specimen diametrically opposite to where the back bend test bar was taken. One of the remaining two test bars of the specimen shall be subjected to the reduced section tensile test and the other to the nick-break test.

Fabrication and Installation of

The World's Largest Piping

By W. A. Cather*



Top left—The edges are planed to proper size and prepared for welding. Top right—Vertical plate-bending roll. Lower left—Ends of the section are milled in a large special lathe. Lower right—Portable X-ray equipment

CERTAIN details of the fabrication of the gigantic welded-steel pipes being made for Boulder Dam are of interest, as they show how radically manufacturing is affected when pipes of much larger size than usual are made. The pipes will be located in the hydraulic-power and outlet-works tunnels.

As the diameters of most of the pipes are too great to permit shipment by rail, it was necessary to build a complete fabricating plant about a mile from the site of the dam, at Bechtel, Nevada. This fabricating plant is modern and complete in every respect.

It will be of interest to follow the fabrication, testing and installation of a typical large erection section through the several stages of the work. Each of the 30-ft sections is composed of six plates 12 ft wide, a little less than 31½ ft long and as thick as 2¾ in. Each plate weighs nearly 23 tons, and a finished erection-section, ready to leave the shop, about 170 tons. The plate, made of special steel, is taken into the shop by one of three 75-ton traveling cranes, is laid out to pattern, and the edges are planed to proper size and prepared for welding by a large planer. It is then moved to the vertical plate-bending roll—the most powerful ever designed for this purpose—where it is rolled from flat to cylindrical form. After forming, three of the plates for a half-length section are brought together and held in their positions, mounted on a carriage equipped with rollers to facilitate turning until the seam is in proper position under an automatic fusion-welding machine. These automatic machines are mounted over the seams for longitudinal and girth welding.

Representative welded sample plates are obtained by tack-welding sample plates to the ends of a longitudinal joint in the shell. Deposition of the weld joint is made continuously through the main joint and sample joint, so that the welded seams of the test plate are representative of the main welded seams of the shell. From these test plates the various test specimens are obtained. There are three longitudinal welds in each of these half-sections, and two half-sections are assembled with a special fillet insert or stiffener member between them, after which the girth seams are welded.

All welded seams are examined by 300,000-volt portable X-ray equipment which makes a permanent photographic film of every inch of the weld. The machine will readily make photographic representations through 4 in. of metal. The amount of X-ray film used in investigating the more than 400,000 linear feet of welding will exceed the total of all that used to date in this country for industrial purposes.

The section is reinforced by the addition of an external T-shaped stiffening ring, welded in place on the fillet insert section. A bracket is welded on each side of the stiffening ring to bear upon the concrete supports in the tunnels.

The next operation is stress-relieving the erection-section in a car-bottom furnace, said to be the largest of this type ever built for this purpose; it is oil-fired with the combustion chamber separate from the furnace. The section is heated to proper temperature for stress-relieving and held at this temperature for a period of time depending on the thickness of plate, the temperature then being allowed to drop slowly.

The welded test coupons are then removed and subjected to tension, bending, and specific gravity tests in the plant laboratory.

The ends of the section are milled in a large special lathe to provide for the final fit in the field. The sections are finally shot-blasted inside, given a primer coat of water-gas tar and a final coat of coal-gas tar, inside and outside, and are ready to be moved to the canyon.

Special artillery-type carriages are used to transport the sections from the plant to the rim of the canyon. From that point they are transported by a cableway spanning the canyon to any one of four landing ledges, two of which are on each side of the canyon. From the landing ledges special carriages carry the sections through construction tunnels to their final position.

To facilitate the final connecting of the many pipe lengths, the sections are of the bell-and-spigot type, one end of each section carrying a projecting buttstrap which will slip over and be secured by pins or rivets to the spigot end of the adjoining section.

It is, of course, out of the question to provide expansion joints to absorb the movement due to expansion and contraction either during the erection period or afterwards. Accordingly, the pipes will be secured to massive steel and concrete anchors, placed about 400 ft apart; during erection, one circumferential pipe-joint midway between each pair of anchors will be left open temporarily and the final connections made after the pipe has been cooled to the approximate temperature of the water. It may be possible to make these connections during the winter, when the temperature drops to as low as 20 F outside the tunnels, and when the air in the tunnels may be sufficiently cold for the purpose, but if that is not feasible, artificial cooling will be employed.

*The Babcock & Wilcox Co., New York City.

Where Cool Condenser Water is Available, Steam Jet Unit Can be Used to

Save in Air Conditioning Cost

By **A. A. Browne***

IN the complete engineering analysis of any air conditioning problem, a number of refrigerating cycles must be considered. Some particular operating conditions are very favorable for one type of equipment whereas these same operating conditions may seriously penalize the cost or performance of some other machine. It is the object of this article to point out one particular condition which is well suited to a steam jet application. Such a condition exists when comparatively cold (deep well) water is available and when the temperature of this water falls within the cooling range of the refrigeration cycle. In order to show the extent of the advantages of this arrangement, a comparison is given here.

The Process of Vacuum Cooling

A number of papers have been written describing the theory of operation of steam jet vacuum cooling units. However, the subject is still new to many air conditioning engineers.

The process of vacuum cooling makes use of the fact that water boils and evaporates at comparatively low temperatures when the pressure above the water is lowered. It is well known that water cannot evaporate unless heat is added (the latent heat of evaporation). Since no external heat is supplied, the heat of evaporation must come from the portion of the liquid which is not evaporated and as a result the temperature of the remaining liquid is lowered.

*Steam Division, Westinghouse Electric & Manufacturing Co., South Philadelphia Works.

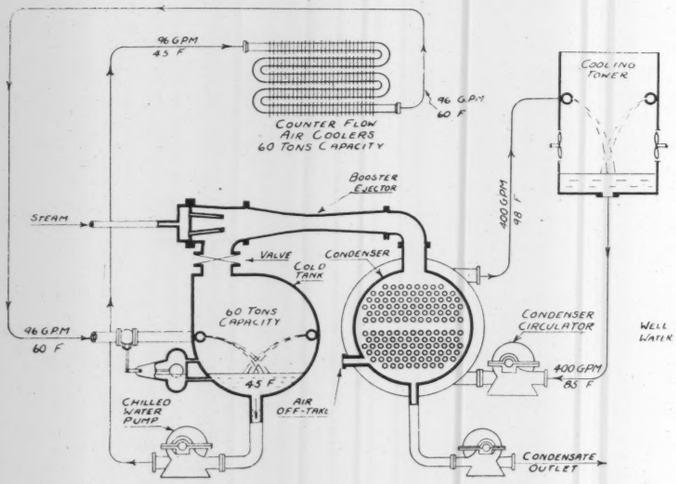
There are numerous methods of maintaining a low pressure or vacuum above the water, one of which is the booster ejector. It is particularly adapted to this type of service because of its ability to handle enormous volumes of rarified water vapor in a small size unit and because it has no moving parts.

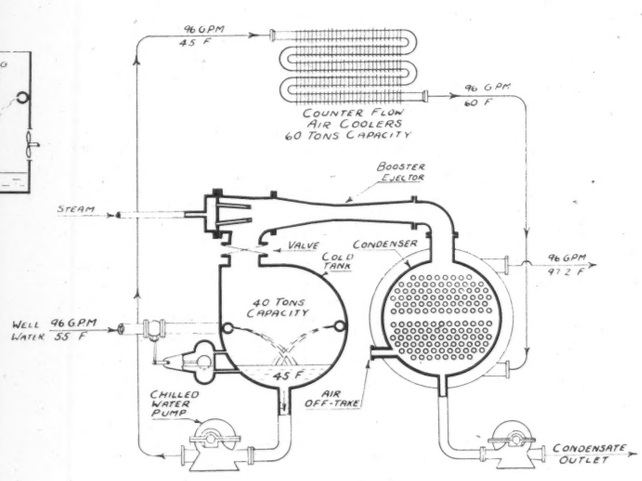
The booster ejector has two functions to perform—First, it must remove relatively large volumes of water vapor at low pressure from the cold tank, and second, it must compress this vapor and its own propelling steam to such a pressure that the mixture can be condensed in a suitable condenser with cooling water at ordinary temperatures. Fig. 1 shows a simplified arrangement of cold tank, booster ejector and surface condenser. Live steam is conducted to the booster and is expanded through one or more nozzles and is discharged therefrom at a high velocity. The high velocity steam jets entrain water vapor from the cold tank and the mixture of water vapor and propelling steam is compressed in the body or diffuser of the ejector and then discharged into the condenser. An air removal apparatus and condensate pump serve the condenser to keep the air tension down to a minimum and to remove the condensed steam and vapors.

Cooling Tower Application

In cases where cooling water for the condenser is expensive or scarce, a cooling tower may be used to provide condenser water, and Fig. 1 shows a schematic arrangement of this kind. A maximum water tempera-

Fig. 1 (Left)—Diagrammatic arrangement of steam jet vacuum cooling unit, showing air coolers and cooling tower. Fig. 2 (Right)—Diagrammatic arrangement of steam jet vacuum cooling unit showing continuous, series flow of well water through the complete system





***WHERE DEEP WELL WATER** is available at a temperature within the cooling range of the refrigerating water, a very economical steam jet vacuum cooling application is possible, which makes for a reduced capacity unit, fewer pumps, lower pumping costs, lower steam consumption and does not require a cooling tower. Other refrigeration cycles can be arranged to utilize to some extent the available refrigeration in the well water, within the limitations described.*

ture off the tower of 85 F is arbitrarily assumed. When the temperature is less than this, the amount of water to the condenser can be decreased or the full 400 gpm of cooling water can be used and as a result an improved vacuum can be obtained in the condenser. With a vacuum higher than the design condition, the amount of steam to the booster ejectors can be reduced by throttling.

For this particular problem assume that it is necessary to obtain 60 tons of refrigeration in a group of counterflow air coolers. The chilled water shall enter these coolers at 45 F and leave at 60 F. The gpm to be circulated is calculated as follows:

$$\text{gpm} = \frac{12{,}000 \times 60}{500 \times 15} = 96,$$

when 60 = tons of refrigeration
15 = cooling range of water in degrees Fahrenheit
500 = conversion factor from gpm to lb per hr
12,000 = Btu per hr per ton of refrigeration

On the assumption that the outlet chilled water temperature of the cold tank will be the same as the inlet temperature to the air coolers, we will require a steam jet unit of 60 tons capacity. As auxiliary equipment for the unit, there will be needed a chilled water pump, a condenser circulating pump and a condensate pump.

Deep Well Application

There are many locations where it is possible to obtain comparatively cool water in considerable quantities from deep wells. Usually this water, as it comes from the well, is not sufficiently cool to provide economical and satisfactory air conditioning. However, if this well water is sprayed directly into the cold tank of a vacuum cooling unit, it can easily be chilled down to the desired temperature. Fig. 2 shows a diagrammatic sketch of a steam jet vacuum cooling unit arranged so that 96 gpm of 55 F well water is sprayed directly into the cold tank, where it is cooled to 45 F. This water is withdrawn from the cold tank and pumped through counterflow air coolers of 60 tons refrigerating capacity. The water on leaving the air coolers at 60 F continues in series through the booster ejector condenser. No additional cooling water is needed for the condenser.

It should be noted that 96 gpm of water through the air coolers and a cooling range of 15 degrees, corresponds to 60 tons refrigeration, whereas the refrigeration capacity of the steam jet unit needs to be only 40 tons because the cooling range of the cold tank is only 10 degrees. Obviously the first cost of the steam jet unit for this condition is less than when a 60 ton unit is needed. Also, with this arrangement no condenser circulating pump is necessary since the chilled water pump serves two purposes. The first cost of a cooling tower and also its pumping costs are eliminated. However if a well is not already available, the cost of drilling it, as well as the pumping costs, must be considered. Since the unit in this case is of only 40 tons capacity, it will require approximately ⅔ as much booster steam as the 60 ton unit used in the first case.

Of course, the method of obtaining some refrigeration from the deep well water is applicable to other refrigeration cycles. However, the full benefit cannot be obtained if the refrigerant is other than water because some type of heat exchanger must be used. This means that a temperature difference of some 5 or 10 degrees is lost in the heat transfer apparatus. With a steam jet vacuum cooling unit, there is no temperature difference between the refrigerant and the cooling medium to be circulated, since they are one and the same.

Pollen Asthma—

(*Continued from page* 331)

disappearance of symptoms was also more rapid than was observed in 1932.

Conclusions

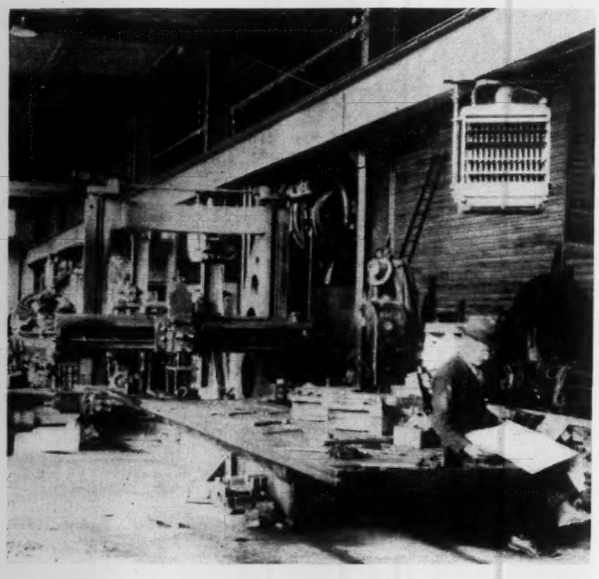
1. On the basis of our results this year on pollen asthmatics, which showed that complete relief was obtained in four days in 16 patients out of 22, we are led to conclude that the rapidity with which pollen asthmatics are relieved is greater under conditions of low humidity and relatively constant temperature in pollen-free atmosphere, than when the temperature and humidity are not controlled.

2. In a pollen-free atmosphere with the relative humidity ranging between 15 and 40 per cent and the temperatures ranging between 72 and 82 F, patients with pollen asthma had a delayed onset (6-8 hours) of symptoms in attacks precipitated by storms. This conclusion is based on a comparison with the time of onset (1 hour) of symptoms in the patients in our experimental ward in 1932.

It is our impression that the asthmatic attacks in the ward during storms were less severe and that the symptoms disappeared much more rapidly as compared to attacks precipitated during the experimental period of 1932.

3. Under our experimental conditions, a concentration of ozone considerably greater than occurs after a heavy electrical storm, showed no beneficial or detrimental effects.

4. Some other factor, or factors, outside of pollen, humidity, temperature, or the concentration of ozone must play a role in the precipitation of symptoms of asthma in pollen asthmatics. Barometric changes and ionization have not as yet been studied.



By **Herbert Chase***

Gas-Fired Unit Heaters Solve Many Plant Heating Problems

THERE are surprises in store for heating engineers who have not investigated the possibilities of gas-fired unit heaters, especially as applied to industrial and some other installations where continuous heating is not essential. Besides marked savings in initial cost of equipment there are economies in fuel cost and other operating costs which should not be overlooked.

Gas is seldom the cheapest fuel when judged on a heat content basis only. Heating costs, however, involve many other items besides fuel. It is not contended, either, that gas can always compete to advantage over other fuels, even when used in the best way possible. Moreover, when steam is required for manufacturing and other purposes in any case and is available for heating as a more or less waste product or by product, gas as a fuel may well be crowded out on an economy score. Finally, it is not contended that all the advantages cited for gas-fired unit heaters and heating are exclusive with this type. Some of them are shared with other unit heaters. Each type, in fact, has its place, and each installation must be considered on its merits with each factor being given due weight.

Perhaps many engineers are in the same position as the writer was when charged recently with selection of a heating system for a hall to be used only a few hours a week for social and recreational purposes. The building is similar to many factories in that it has a high center bay with lower side bays and with the side walls of each largely glass. First impressions were that a steam heating system using either unit heaters or conventional radiators and either a coal-fired or an oil-fired boiler would be appropriate, but when a large New York steam heating contractor was consulted and a gas unit heater system was recommended (despite the fact that this seemed detrimental to the contractor's immediate interest) an investigation was made.

*Mechanical Engineer, Forest Hills, N. Y.

It developed that the cost of the latter system for this particular job would be less than half that of a coal-fired steam system and less than a third of that of an oil-fired steam system, installation cost of both included in all cases. This meant a saving in interest charges alone of around $150 a year, besides other economies. The only attendance required is to set the thermostat at the temperature desired, which is about 50 F for most of the week. When the hall is required for assembly purposes, the temperature can be raised usually an average of about 10 F an hour up to 70 F. Although operation is not noiseless, the noise is not sufficient to be objectionable to most people and and could be further reduced by application of sound absorbing materials. A single unit with short ducts discharging about 8 ft above the floor at each side of a stage at one end of the room serves to heat the entire building which measures 72 by 86 ft and has a 19-ft ceiling in the high bay.

In this, as in other installations, the unit includes a fan or blower discharging through a chamber containing vertical tubes through which the products of combustion rise. Automatic controls are provided to open and shut the main gas valve when the blower is started and stopped by the room thermostat. A pilot light burns constantly and there is a safety device which prevents opening of the gas valve in the event that the pilot should go out. Another limit control prevents over-heating in the event that the blower should fail to function. In general, products of combustion are vented to the outdoors, but in some cases the products of combustion discharge into the room so that stack losses are avoided. In such cases all the heat from the fuel is used to heat the room. Even when outdoor vents are used, the heating efficiency is high.

An important economy is that no fuel is consumed except when heat is required (disregarding that for the pilot lights, which is insignificant). When heat is re-

(*Continued on page 86, back section*)

Heating · Piping
and Air Conditioning

American Society of Heating and Ventilating Engineers JOURNAL SECTION

1895

AUGUST 1934

Table of Contents

Influence of Stack Effect on the Heat Loss in Tall Buildings, by Axel Marin 349
Operating Results of an Air Conditioning System Compared with Design Figures, by John R. Hertzler 354
Proceedings of the Semi-Annual Meeting 1934 359
Fun at Buck Hill Falls 366
Local Chapter Reports 368
Candidates for Membership 371
Candidates Elected 372

The material in this Section is prepared by the Publication Committee of the Society and nothing that appears in it may be reprinted, either wholly or in part, without permission. The use of the Society's name for advertising promotions is never authorized.

OFFICERS AND COUNCIL 1934

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
51 Madison Ave., New York, N. Y.

President ..... C. V. HAYNES
First Vice-President ..... JOHN HOWATT
Second Vice-President ..... G. L. LARSON
Treasurer ..... D. S. BOYDEN
Secretary ..... A. V. HUTCHINSON

COUNCIL

C. V. HAYNES, *Chairman* — JOHN HOWATT, *Vice-Chairman*

One Year

ALBERT BUENGER — F. E. GIESECKE — W. T. JONES
J. F. MCINTIRE — W. E. STARK

Two Years

R. H. CARPENTER — J. D. CASSELL — F. C. MCINTOSH
L. W. MOON

Three Years

M. C. BEMAN — E. H. GURNEY — O. W. OTT
W. A. RUSSELL

COMMITTEES OF THE COUNCIL

Executive: JOHN HOWATT, *Chairman*
J. D. CASSELL — E. H. GURNEY

Finance: R. H. CARPENTER, *Chairman*
F. C. MCINTOSH — J. F. MCINTIRE

Meetings: W. E. STARK, *Chairman*
F. E. GIESECKE — L. W. MOON

Membership: F. C. MCINTOSH, *Chairman*
ALBERT BUENGER — W. A. RUSSELL

ADVISORY COUNCIL

W. T. Jones, *Chairman;* W. H. Carrier, Homer Addams, R. P. Bolton, S. E. Dibble, W. H. Driscoll, H. P. Gant, John F. Hale, L. A. Harding, H. M. Hart, E. Vernon Hill, J. D. Hoffman, S. A. Jellett, D. D. Kimball, S. R. Lewis, Thornton Lewis, J. I. Lyle, J. R. McColl, D. M. Quay, C. L. Riley, F. B. Rowley, F. R. Still and A. C. Willard.

COOPERATING COMMITTEES

A. S. H. V. E. representative on *National Research Council;* Prof. F. E. Giesecke (3 years).

SPECIAL COMMITTEES

Committee on Admission and Advancement: A. J. Offner, *Chairman (two years);* J. G. Eadie *(one year),* and E. N. Sanbern *(three years).*

Publication Committee: W. M. Sawdon, *Chairman;* A. P. Kratz and M. C. Beman.

Committee on Constitution and By-Laws: Thornton Lewis, *Chairman;* W. T. Jones and O. W. Ott.

Guide Publication Committee: W. L. Fleisher, *Chairman;* John Howatt, G. L. Larson, S. R. Lewis, E. N. McDonnell, W. M. Sawdon and J. H. Walker.

Committee on Ventilation Standards: W. H. Driscoll, *Chairman:* J. J. Aeberly, L. A. Harding, D. D. Kimball, J. R. McColl, C. L. Riley, W. A. Rowe, Perry West and A. C. Willard.

Committee on Code for Testing and Rating Condensation and Vacuum Pumps: John Howatt, *Chairman;* W. H. Driscoll, L. A. Harding and F. J. Linsenmeyer.

Committee on Code for Testing and Rating Convectors: R. N. Trane, *Chairman;* E. H. Beling, R. F. Connell, M. Dillman, W. Ewald, J. H. Holbrook, Hugo Hutzel, A. P. Kratz, M. G. Steele and O. G. Wendel.

NOMINATING COMMITTEE FOR 1934

Chapters	*Representative*	*Alternate*
Cincinnati	J. J. Braun	H. E. Sproull
Cleveland	C. F. Eveleth	F. A. Kitchen
Illinois	J. J. Aeberly	J. J. Hayes
Kansas City	W. A. Russell	E. K. Campbell
Massachusetts	J. F. Tuttle	W. F. Gilling
Michigan	W. G. Boales	Tom Brown
Western Michigan	S. H. Downs	J. H. Van Alsburg
Minnesota	N. D. Adams	C. E. Lewis
New York	H. W. Fiedler	V. J. Cucci
Western New York	D. J. Mahoney	J. J. Yager
Ontario	H. S. Moore	F. E. Ellis
Pacific Northwest	A. L. Pollard	Lincoln Bouillon
Philadelphia	W. R. Eichberg	M. F. Blankin
Pittsburgh	F. C. McIntosh	F. C. Houghten
St. Louis	R. J. Tenkonohy	
Southern California	L. H. Polderman	R. L. Gifford
Wisconsin	E. A. Jones	Ernest Szekely

COMMITTEE ON RESEARCH

JOHN HOWATT, *Chairman*

F. E. GIESECKE, *Vice-Chairman* — PROF. A. C. WILLARD, *Technical Adviser* — F. C. HOUGHTEN, *Director*

O. P. HOOD, *Ex-Officio Member*

One Year

D. E. FRENCH, F. E. GIESECKE, L. A. HARDING, G. L. LARSON, A. P. KRATZ

Two Years

ALBERT BUENGER, S. H. DOWNS, H. N. KITCHELL, H. R. LINN, PERRY WEST

Three Years

C. A. BOOTH, E. K. CAMPBELL, JOHN HOWATT, A. J. NESBITT, J. H. WALKER

Executive Committee

JOHN HOWATT, *Chairman*

F. E. GIESECKE, H. R. LINN

Finance Committee

A. J. NESBITT, *Chairman*

N. D. ADAMS, E. C. EVANS, G. L. LARSON, J. H. WALKER

TECHNICAL ADVISORY COMMITTEES - 1934

Air Conditions and Their Relation to Living Comfort: C. P. Yaglou, *Chairman;* J. J. Aeberly, W. L. Fleisher, D. E. French, Dr. R. R. Sayers and Dr. C.-E. A. Winslow.

Air Conditioning in Treatment of Diseases: Dr. E. V. Hill, *Chairman;* N. D. Adams, J. J. Aeberly, Margaret Ingels, H. R. Linn and E. L. Stammer.

Atmospheric Dust and Air Cleaning Devices (Including Dust and Smoke): H. C. Murphy, *Chairman;* J. J. Bloomfield, M. I. Dorfan, Philip Drinker, Dr. Leonard Greenburg, S. R. Lewis, T. W. Pangborn, F. B. Rowley and Games Slayter.

Correlating Thermal Research: R. M. Conner, *Chairman;* D. S. Boyden, J. C. Fitts, H. T. Richardson and Perry West.

Corrosion: J. H. Walker, *Chairman;* H. F. Bain, E. L. Chappell, W. H. Driscoll and R. R. Seeber.

Direct and Indirect Radiation with Gravity Air Circulation: H. F. Hutzel, *Chairman;* A. P. Kratz, H. R. Linn, J. F. McIntire, J. P. Magos, T. A. Novotney, R. N. Trane and G. L. Tuve.

Gas Heating Equipment: W. E. Stark, *Chairman;* Robert Harper, E. A. Jones, Thomson King, J. F. McIntire, E. L. Tornquist and H. L. Whitelaw.

Heat Requirements of Buildings: D. S. Boyden, *Chairman;* P. D. Close, W. H. Driscoll, H. M. Hart, P. E. Holcombe, V. W. Hunter, F. B. Rowley, R. J. J. Tennant and J. H. Walker.

Heat Transfer of Finned Tubes with Forced Air Circulation: F. B. Rowley, *Chairman;* H. F. Bain, H. F. Hutzel, W. G. King, A. P. Kratz, E. J. Lindseth, L. P. Saunders, G. L. Tuve and W. E. Stark.

Minimum Temperature and Method of Introduction of Cooling Air in Classrooms: Perry West, *Chairman;* J. D. Cassell, S. R. Lewis, J. R. McColl, A. J. Nesbitt, G. E. Otis and C.-E. A Winslow.

Oil Burning Devices: H. F. Tapp, *Chairman;* Elliott Harrington, F. B. Howell, J. H. McIlvaine, L. E. Seeley and T. H. Smoot.

Pipe and Tubing (Sizes) Carrying Low Pressure Steam or Hot Water: S. R. Lewis, *Chairman;* J. C. Fitts, F. E. Giesecke, H. M. Hart, C. A. Hill, R. R. Seeber and W. K. Simpson.

Refrigeration in Relation to Air Treatment: A. P. Kratz, *Chairman;* E. A. Brandt, John Everetts, Jr., E. D. Milener, K. W. Miller, E. B. Newill, F. G. Sedgwick and J. H. Walker.

Sound in Relation to Heating and Ventilation: V. O. Knudsen, *Chairman;* Carl Ashley, C. A. Booth, F. C. McIntosh, R. F. Norris, J. S. Parkinson, C. H. Randolph, J. P. Reis and G. T. Stanton.

Ventilation of Garages and Bus Terminals: E. K. Campbell, *Chairman;* S. H. Downs, T. M. Dugan, E. C. Evans, F. H. Hecht, H. L. Moore and A. H. Sluss.

OFFICERS OF LOCAL CHAPTERS, 1933-1934

CLEVELAND
Headquarters, Cleveland
Meets: Second Thursday in Month
President, F. A. KITCHEN
1514 Prospect Ave.
Secretary, M. B. WRIGHT
Case School of Applied Science.

CINCINNATI
Headquarters, Cincinnati, O.
Meets: Second Tuesday in Month
President, H. N. KITCHELL
4528 Circle Ave.
Secretary, E. B. ROYER
6635 Iris Ave.

ILLINOIS
Headquarters, Chicago
Meets: Second Monday in Month
President, C. W. DELAND
211 N. Desplaines St.
Secretary, J. J. HAYES
53 W. Jackson Blvd.

KANSAS CITY
Headquarters, Kansas City, Mo.
Meets: Second Monday in Month
President, DAVID CALEB
1330 Baltimore Ave.
Secretary, C. A. WEISS
1811 Troost Ave.

MASSACHUSETTS
Headquarters, Boston
Meets: Second Monday in Month
President, R. S. FRANKLIN
38 Chauncy St.
Secretary, W. A. MCPHERSON
86 Dwinnell St.
West Roxbury, Mass.

MICHIGAN
Headquarters, Detroit
Meets: First Monday after the 10th of the Month
President, G. D. WINANS
2000 Second Ave.
Secretary, W. F. ARNOLDY
2847 Grand River Ave.

WESTERN MICHIGAN
Headquarters, Grand Rapids
Meets: Second Monday in Month
President, S. H. DOWNS,
211 Creston Ave.,
Kalamazoo, Mich.
Secretary, W. G. SCHLICHTING,
528 Pinehurst Blvd.,
Kalamazoo, Mich.

MINNESOTA
Headquarters, Minneapolis
Meets: Second Monday in Month
President, A. B. ALGREN
5109 17th Ave. S.
Secretary, C. E. GAUSMAN
2360 Chilcombe, St. Paul, Minn.

NEW YORK
Headquarters, New York
Meets: Third Monday in Month
President, H. W. Fiedler
489 Fifth Ave.
Secretary, T. W. REYNOLDS
100 Pinecrest Drive,
Hastings-on-Hudson, N. Y.

WESTERN NEW YORK
Headquarters, Buffalo
Meets: Second Monday in Month
President, J. J. YAGER
425 Woodbridge Ave.
Secretary, P. S. HEDLEY
Curtiss Bldg.

ONTARIO
Headquarters, Toronto, Can.
Meets: First Monday Every Other Month
President, W. R. BLACKHALL
332 Waverley Rd.
Secretary, H. R. ROTH
1104 Bay St.

PACIFIC NORTHWEST
Headquarters, Seattle, Wash.
Meets: Second Tuesday in Month
President, A. L. POLLARD
601 Electric Bldg.
Secretary, S. D. PETERSON
473 Colman Bldg.

PHILADELPHIA
Headquarters, Philadelphia
Meets: Second Thursday in Month
President, W. P. Culbert
2019 Rittenhouse St.
Secretary, W. R. EICHBERG
4210 Sansom St.

PITTSBURGH
Headquarters, Pittsburgh
Meets: Second Monday in Month
President, P. A. EDWARDS
608 Wabash Bldg.
Secretary, J. L. BLACKSHAW
3728 Dawson St.

ST. LOUIS
Headquarters, St. Louis
Meets: First Wednesday in Month
President, PAUL SODEMANN
4136 Farlin Ave.
Secretary, A. L. WALTERS
7284 Richmond Pl.,
Maplewood, Mo.

SOUTHERN CALIFORNIA
Headquarters, Los Angeles
Meets: Second Tuesday in Month
President, W. H. C. NESS
1323 Channing St.
Secretary, E. H. KENDALL
309 West 12th St.

WISCONSIN
Headquarters, Milwaukee
Meets: Third Monday in Month
President, JOHN S. JUNG
1516 S. Layton Blvd.
Secretary, G. E. HOCHSTEIN
3000 W. Montana St.

Influence of Stack Effect on the Heat Loss in Tall Buildings

By **Axel Marin,* Ann Arbor, Mich.**

(NON-MEMBER)

THE purpose of this paper is to present the results of investigations made in the Penobscot Building, Detroit, Mich., to determine the influence of stack effect on the heat loss from a tall building. The tests conducted in this building are the first in a series to be made in investigating this subject, and the results should not be interpreted as applying to any building until additional tests with other buildings have shown similar agreement between the calculated heat loss and the heat input as determined by test. The investigations are to be carried on during the next heating season at Detroit, and it is hoped when these tests are completed that the influence of stack effect on heat losses in tall buildings may be properly accounted for.

By *stack effect,* as applied to tall buildings, is meant the pressure difference existing between the inside and outside of a building due to the temperature difference. This pressure difference tends to increase the inflow of air on the lower floors of a building by adding to the wind effect and opposes the effect of the wind at the upper floors. For any given inside and outside temperature, the pressure difference at any elevation is theoretically proportional to the distance this place is from the neutral zone.[1]

The work is being done in cooperation with the Technical Advisory Committee on Heat Losses from Buildings of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. It was made possible through the courtesy of the owners of the Penobscot Building and the building engineer, Mr. G. M. Lewis, who made available space for the study and assisted in every manner possible; and the Detroit Edison Co. who installed all the test equipment, made all the arrangements, and collected the test data.

The Building

The Penobscot Building, Fig. 1, is a modern 47-story office building located at the corner of Griswold and Fort Streets, Detroit, Mich. It is 565 ft from street level to roof, has a volume of 6,858,360 cu ft, and contains 73,940 sq ft of direct radiation and 19,250 sq ft of equivalent radiation in fan coils.

Fig. 2 shows a ground plan of the Penobscot Building and the other buildings in the immediate vicinity with their elevations indicated. Fig. 3 is a cross-section of the 8th floor which is the same for all floors up to the 31st floor. The cross-section decreases slightly from this point up to the top floor by set-backs at approximately every four floors.

Fig. 1—Penobscot Building, Detroit, Mich.

General Plan

In planning the tests to determine the influence of stack effect on heat loss from a tall building, it seemed advisable to investigate at least three rooms in a building that have the same directional exposure and that are as nearly alike in every respect as possible with the exception of elevation.

Test Rooms

Three rooms on the north side of the Penobscot Building midway from the corners were used for the first series of tests—one on the 8th floor, one on the 21st floor, and the other on the 32nd floor. Figs. 4 and 5 show the test rooms on the 21st and 32nd floors with the testing equipment in place, and Fig. 6 is a plan view of the 8th floor test room with the details of the outside

*Associate Professor of Mech. Engineering, University of Michigan.

[1]The Neutral Zone in Ventilating, by J. E. Emswiler, TRANSACTIONS A. S. H. V. E., Vol. 32, 1926.

Presented at the Semi-Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, June, 1934, Buck Hill Falls, Pa.

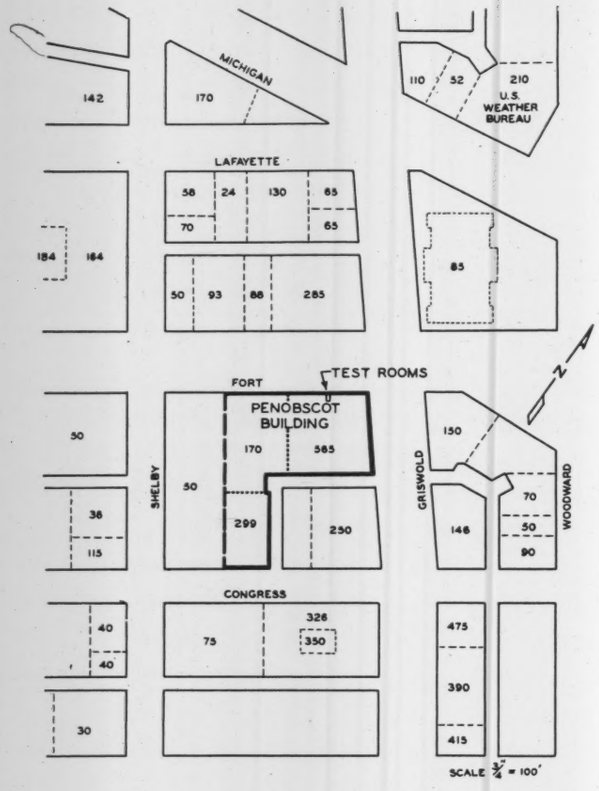


Fig. 2—Plan showing location of Penobscot Building with respect to surrounding buildings and their heights

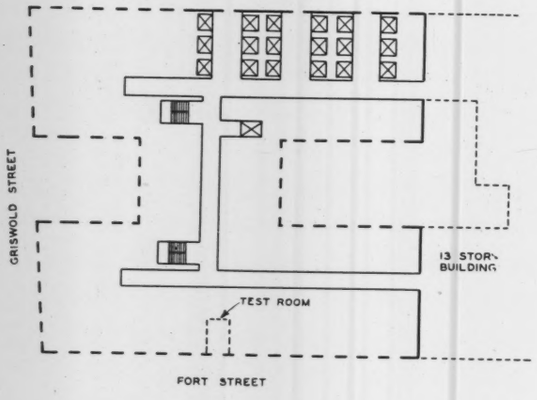


Fig. 3—Cross-section of building at 8th floor

wall. Table 1 gives the area of the exposed wall and glass for each room, the calculated transmission loss in Btu per hour per degree temperature difference for wall and glass, the lineal feet of crack for the windows, and the elevation of the test floors above the ground.

Table 1—Location, Exposure and Heat Loss of Test Rooms

Test Room	Exposed Wall Sq Ft	Exposed Glass Sq Ft	Lineal Ft of Crack	Calculated Transmission Loss—Btu per Hour per Degree Temperature Difference	Distance from Ground to Mid-height of Test Rooms
8th Floor	57.6	29.6	26.67	48.53	105 ft 6 in.
21st Floor	120.06	59.2	53.34	94.67	253 ft 4 in.
32nd Floor	67.2	29.6	26.67	47.40	378 ft 10 in.

Description of Apparatus and Tests

The amount of steam supplied to the radiators was determined by collecting and weighing the condensate. Special flat tanks were constructed for this purpose that could be disconnected quickly, the accumulated condensate weighed, and the tank connected again. The heat output of the radiators was manually controlled by throttling the radiator valve to maintain a constant temperature in the test room. The pressure of the steam supplied and the temperature of the condensate leaving the radiator were recorded, making it possible to determine the heat output of the radiator. Temperature of the air in the test room at 6-in. and 5-ft levels from the floor and 6 in. from the ceiling were recorded at 15-min intervals, as well as the temperatures of the outside air and the temperatures of the surrounding rooms.

The wind velocity and direction, the per cent of possible sunshine, the barometric pressure, and the outside temperature were obtained from the local weather bureau, which is located at the Majestic Building about three blocks away. The outside temperature obtained by thermometers suspended outside the windows at the various floors and 6 in. away from the wall surface were used in calculating the heat loss. These temperatures were practically identical with the temperatures reported by the weather bureau.

An attempt was made to measure the amount of in-

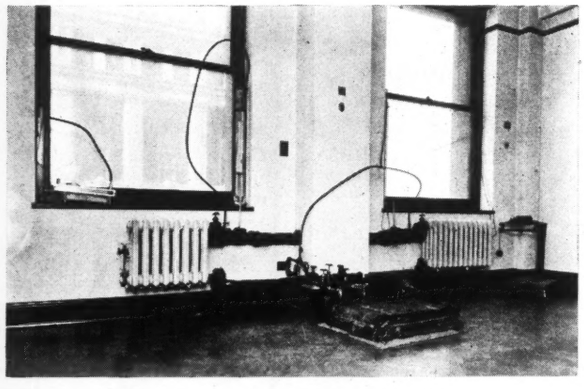


Fig. 4—Test room on 21st floor

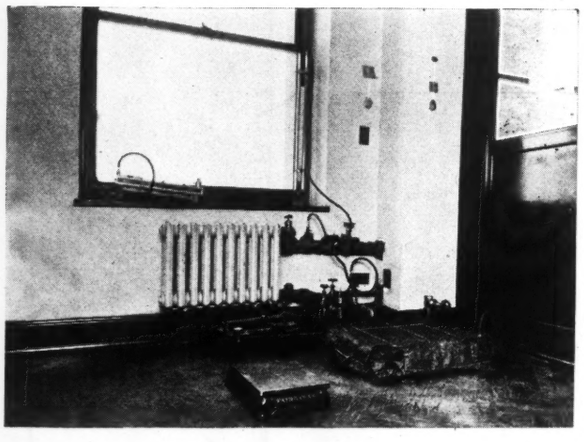


Fig. 5—Test room on 32nd floor

Table 2—Summary of Results

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII
Date	Room Number	Inside Temperature 5 ft. level	Inside Relative Humidity in percent	Btu Input per Hour From Steam	Btu Input per Hour From Steam Corrected To 72.6F—Room Temp.	Btu Input per Hour From Steam Corrected To 72.6F—Room Temp. & 8th Floor Exposure	Btu Loss per Hour Through Walls and Glass (Calculated for 72.6F)	Btu Loss per Hour Due to Infiltration Based on Actual Pressure Drop Through Windows and Doors (Calculated for 72.6F Inside)	Btu Loss per Hour Due to Infiltration Based on Data Given in Table 4 for 15 mph Normal Wind (72.6F Inside)	Total Btu Loss per Hour Col.VIII plus Col.IX (Calculated)	Total Btu Loss per Hour Col.VIII plus Col.X (Calculated)	Actual Pressure Drop Through Windows Inches of Water	Outdoor Temperature (Observed)	Outdoor Relative Humidity in Percent (U.S.Weather Bureau)	Wind Velocity (mph) and Direction (U.S.Weather Bureau)	Percent of Possible Sunshine (U.S.Weather Bureau)	Barometric Pressure Inches of Hg (U.S.Weather Bureau)
1-27-34	853	70.2	20.0	5806.7	6030.0		3266.0	1776.0	1668.0	5042.0	4934.0	-.208					
	2153	72.5	21.0	10352.2	5310.0		6371.0	-16.5	2220.0	6354.5	6591.0	+.028	5.3	60.0	19.4 NW	100	29.45
	3250	72.5	21.5	3745.9	3833.0		3390.0	-16.5	414.0	3173.5	3604.0	+.046					
2-27-34	853	73.3	15.0	5958.5	5890.0		3135.0	1541.0	1600.0	4676.0	4735.0	-.177					
	2153	73.0	22.0	6069.7	6030.0		6116.0	-7.0	2220.0	6109.0	6336.0	+.010	8.0	56.0	8.8 W	100	30.02
	3250	73.0	17.0	3015.2	2998.0		3062.0	-63.6	397.0	2998.4	3459.0	+.134					
1-30-34	853	69.2	23.0	5896.5	6225.0		3087.0	1314.0	1575.0	4401.0	4662.0	-.142					
	2153	72.2	20.0	8035.5	8080.0		6021.0	-20.8	2095.0	6121.8	8116.0	-.003	9.0	61.0	15.3 W	100	29.50
	3250	72.1	21.0	3557.9	3580.0		3015.0	-51.5	331.0	2963.5	3346.0	+.117					
2-20-34	853	73.3	17.5	5283.7	5220.0		2870.0	1368.0	1470.0	4238.0	4340.0	-.168					
	2153	73.2	21.0	6887.6	6800.0		5690.0	-22.1	1958.0	5668.9	7572.0	+.084	13.3	54.0	10.5 SW	100	29.51
	3250	72.9	18.5	4691.9	4865.0		4980.0	-44.3	365.0	2766.7	3176.0	+.147					
2-16-34	853	72.6	20.0	4666.6	4666.6		2649.0	1288.0	1362.0	3937.0	4011.0	-.166					
	2153	72.2	25.0	4466.3	4466.0		2898.0	1.6	1815.0	5208.6	7022.0	+.018	17.6	40.0	8.3 NE	100	29.71
	3250	72.6	20.0	2611.3	2611.3		2677.0	-31.0	338.0	2376.0	2945.0	+.128					
1-26-34	853	72.7	33.0	3807.2	3807.2		2063.0	794.0	1043.0	2857.0	3106.0	-.119					
	2153	72.1	28.0	3710.8	3710.0		1902.0	425.0	1402.0	4448.0	5425.0	-.027	30.1	66.0	13.7 SW	75	29.41
	3250	73.0	29.0	3921.1	3993.0		1940.0	-21.4	261.0	1993.6	2276.0	+.103					
3-14-34	853	73.1	24.0	2529.1	2498.0		1999.0	835.0	1020.0	2834.0	3019.0	-.139					
	2153	72.7	26.0	4545.4	4545.4		2330.0	1960.0	1360.0	4551.0	5260.0	-.038	31.4	64.0	8.5 NW	100	29.76
	3250	72.3	24.0	2650.8	2632.0		2695.0	-6.4	253.0	1946.6	2206.0	+.013					
3-7-34	853	73.8	31.0	3385.3	3480.0		1990.0	806.0	1015.0	2796.0	3005.0	-.129					
	2153	73.3	28.0	3842.9	3795.0		3861.0	581.0	1382.0	4462.0	5243.0	-.035	31.6	60.0	15.8 NW	60	29.43
	3250	73.0	23.0	2389.1	2343.0		2400.0	0	252.0	1943.0	2195.0	0					

filtration or exfiltration from the test room by replacing the transom over the door with a tight fitting board that had a one square foot opening, and measuring the velocity at this place with an anemometer. The velocities in all cases were too low to move the anemometer wheel. The infiltration figures used in the calculations were

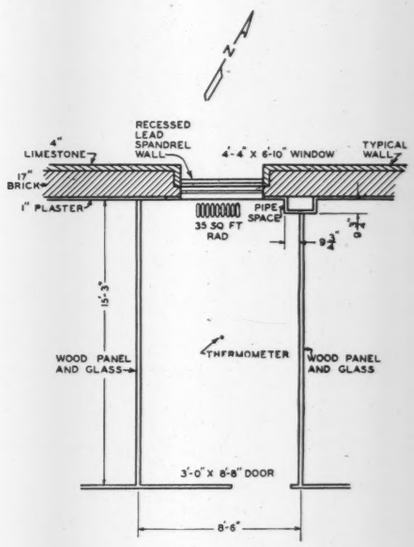


Fig. 6—Plan of test room on 8th floor (11 ft-4 in. ceiling)

based on the results of, Air Leakage Studies on Metal Windows, by Houghten and O'Connell[2] corresponding to the actual pressure drops measured across the windows. The pressure difference was measured with an inclined draft gage connected to copper tubing that extended through a hole drilled in the window sash.

Results

The principal results are presented in Table 2. Column 5 gives the heat input in Btu per hour from the steam to maintain the test rooms at the temperatures indicated in Column 3 for the various outside temperatures listed in Column 14. The figures in Column 5 include the necessary corrections for any heat loss or gain from or to the surrounding rooms.

Column 6 is the heat input from steam corrected to a common inside temperature of 72.6 F. Column 6 is obtained by multiplying the values in Column 5 by the ratio of 72.6 F minus the outside temperature over the actual temperature difference between inside and outside. The temperature 72.6 F is the average room temperature for all tests.

Column 7 shows the amount of heat which would be necessary to maintain the test rooms on the various floors at 72.6 F, if the exposed wall and glass areas were the same as the 8th floor test room.

The calculated transmission loss, Column 8, is the sum of the quantities obtained by multiplying the area in square feet of exposed wall and that of glass by their respective transmission coefficient (U) and by the temperature difference between the air inside and outside.

[2]Transactions A. S. H. V. E., Vol. 34, 1928, p. 321.

The temperature difference is 72.6 F minus the outside temperature.

The transmission coefficient (U) is

$$U = \frac{1}{\frac{1}{f_1} + \frac{1}{f_0} + \frac{x_1}{k_1} + \frac{x_2}{k_2} + \frac{x_3}{k_3}}$$

in which

f_1 and f_0 = Surface coefficients.
k_1, k_2, etc. = The conductivity of the respective material.
x_1, x_2, etc. = The thickness of the various materials in inches.

The outside wall of the 8th floor test room has 38.1 sq ft of stone veneered wall and 19.5 sq ft of a recessed lead spandrel construction. The stone veneered wall is composed of the following material: 1 in. plaster, 17 in. brick, and 4 in. of cut limestone; and the recessed lead spandrel section is made up of 1 in. plaster, 8 in. brick, and a 2½ in. lead spandrel. The glass area for the 8th floor room is 29.6 sq ft. The transmission coefficient for the stone veneered section, using values from THE GUIDE 1934 is

$$U = \frac{1}{\frac{1}{1.65} + \frac{1}{6.0} + \frac{1}{3.3} + \frac{17}{5} + \frac{4}{12.5}} = 0.208 \text{ Btu per hour per sq ft per deg.}$$

and for the recessed spandrel wall

$$U = \frac{1}{\frac{1}{1.65} + \frac{1}{6.0} + \frac{1}{3.3} + \frac{8}{5} + \frac{2.5}{111}} = 0.370 \text{ Btu per hour per sq ft per deg.}$$

The total transmission loss in Btu per hour per degree temperature difference for the exposed wall and glass of the 8th floor test room is equal to

$38.1 \times 0.208 + 19.5 \times 0.370 + 29.6 \times 1.13 = 48.53$

To obtain the total transmission loss for any given temperature difference for the 8th floor room, 48.53 is multiplied by the temperature difference.

The method employed in calculating the transmission loss for the 8th floor test room was also used in calculating the transmission loss for the 21st and 32nd floor test rooms. The 21st floor room has 102 sq ft of stone veneered wall, 18.06 sq ft of recessed spandrel wall, and 59.2 sq ft of glass. The outside wall of the 32nd floor test room has 67.2 sq ft of stone veneered wall and 29.6 sq ft of glass, with no recessed section.

The total calculated heat loss, which is the sum of the transmission loss and the infiltration loss, is shown with the infiltration loss calculated in two different ways. In one case the infiltration loss is based on the actual pressure drop across the window, and in the other case the infiltration loss is based on THE GUIDE method.

THE GUIDE method would be the one a designer would naturally use to determine the infiltration, when calculating the heat losses. This method assumes the neutral zone to be at mid-height, and determines the equivalent wind velocity, due to stack effect and wind, that is responsible for infiltration. The expression used in calculating the equivalent wind velocity, taken from THE GUIDE 1934 is

$$M_e = \sqrt{M^2 - 1.75a}$$

$$M_e = \sqrt{M^2 + 1.75b}$$

where

M_e = Equivalent wind velocity to be used in conjunction with results of Air Leakage Studies on Metal Windows.
M = Wind velocity upon which infiltration would be determined if the temperature difference were disregarded. (Assumed in our computations as 15 miles per hour.)
a = Distance of windows under consideration from mid-height of building if above mid-height.
b = Distance if below mid-height.

Fig. 7 shows the variation in heat supply in Btu per hour to maintain the test rooms at a temperature of 72.6 F at the 5-ft level when the outside temperature varies from 5.3 F to 31.6 F. The calculated values of the heat losses, computed according to the methods previously explained, are also plotted against temperatures to show the relation between the calculated heat loss and outside temperature.

The test points of the heat supplied for the 8th floor test room, shown in Fig. 7, fall on a smooth curve with the exception of the 9 F and 31.4 F points. The 9 F point is high, due no doubt to the 15.3 mile per hour wind from the West, which is almost parallel to the outside wall. The only observed difference in outside conditions for the 9 F point and 8 F point, aside from the 1 deg temperature difference, is the wind velocity. This increased heat supply for the 9 F point may be due to the more rapid removal of the air film on the outside wall, thereby increasing the transmission loss. It does not seem possible to account for this increase as infiltration, because the pressure difference across the window is less for the 9 F test point than for the 8 F test point. It is interesting to note that the same sort of variation in heat supply for the 8 F and 9 F points is present in the curves of heat supply for the 21st and 32nd floor rooms. No reason is known as to why the 31.4 F point is low. The 31.6 F point and the 30.1 F point agree with the other points and they are more rational.

It is evident from the curves of calculated heat loss for the 8th floor room that there is little difference in the results obtained using the two methods of calculating the heat loss, but it is surprising to note that the curve of heat supply is approximately 20 per cent higher than the calculated results throughout the range of outside temperature investigated.

The test curve of heat supply for the 21st floor test room shown in Fig. 7 increases more rapidly in the region of the 5.3 F and 9 F test points than do the curves of heat supply for the other floors in this same temperature region. This increase may be due to the fact that the 21st floor is about at the neutral zone and the conditions of pressure are very unstable, varying from a slight vacuum to a slight pressure during many of the tests.

The reason for the large difference in the two curves portraying the calculated heat loss is due to the two different methods used in calculating the infiltration loss. As has already been pointed out, actual pressure drops across the window show the 21st floor to be at about the neutral zone, while THE GUIDE method assumes the neutral zone to be at mid-height or 29 ft higher than the 21st floor. This 29 ft, plus the 15 mile normal wind used in THE GUIDE method of determining the infiltration loss, is responsible for the difference in the two curves.

The curves in Fig. 7 showing the heat supply and the calculated heat loss for the 32nd floor agree remarkably well with the exception of the 13.3 F test point. There is no known reason for this discrepancy.

Fig. 8 shows the amount of heat which would be required to maintain the test rooms on the various floors at 72.6 F if the exposed wall and glass areas were the same as the 8th floor test room. It is evident from Fig.

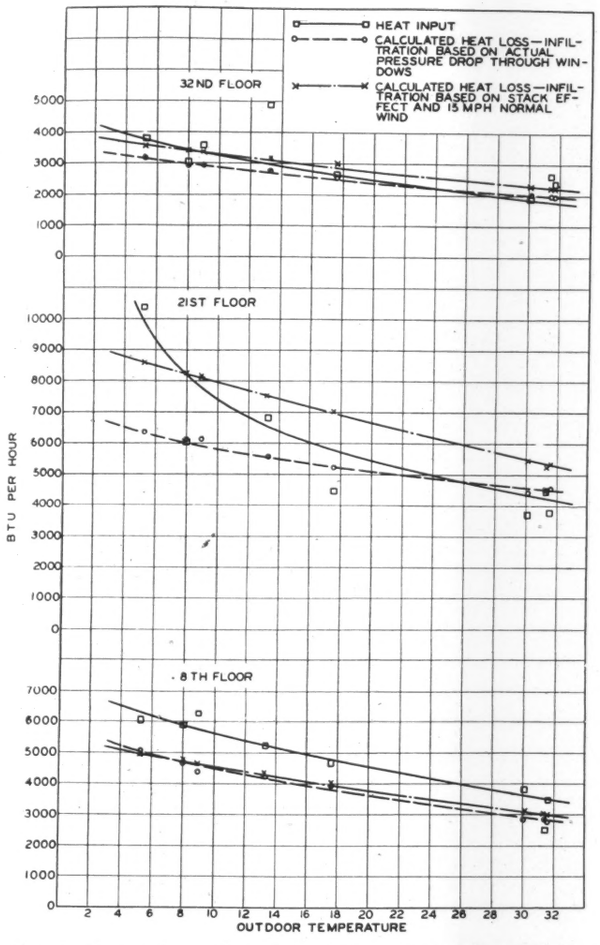

HEAT INPUT
CALCULATED HEAT LOSS—INFILTRATION BASED ON ACTUAL PRESSURE DROP THROUGH WINDOWS
CALCULATED HEAT LOSS—INFILTRATION BASED ON STACK EFFECT AND 15 MPH NORMAL WIND
32ND FLOOR
21ST FLOOR
8TH FLOOR
BTU PER HOUR
OUTDOOR TEMPERATURE

Fig. 7—Comparison of calculated heat loss and actual heat input to maintain test rooms at 72.6 F

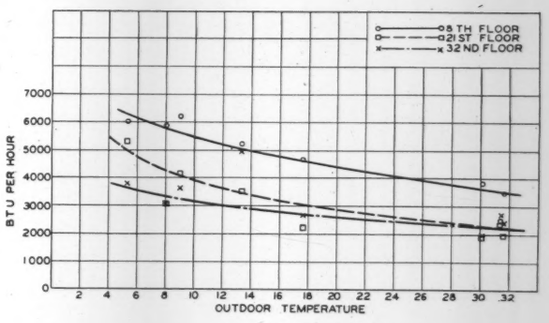


Fig. 8—Btu required to maintain test rooms at 72.6 F reduced to 8th floor exposure as a base for the purpose of comparison

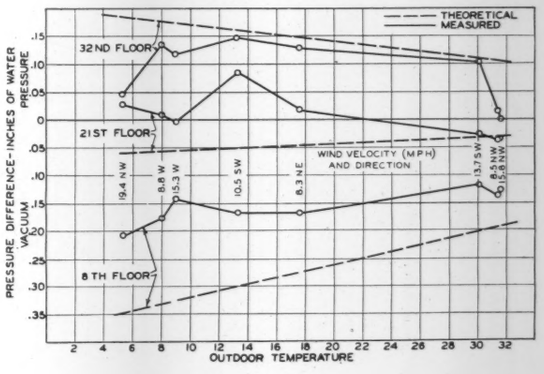


Fig. 9—Comparison of measured pressure difference across windows with theoretical difference due to stack effect

8 that it requires more heat to maintain a temperature of 72.6 F in the 8th floor test room than it would to maintain this same temperature in a room on the 21st or 32nd floor having the same exposure.

Fig. 9 shows the actual pressure difference across the windows for the three test rooms plotted against the outside temperature with the wind velocity and direction indicated for each test point. For the purpose of comparison, the theoretical pressure difference due to temperature difference for each test room is also plotted. In obtaining the values for the theoretical curve, the effective head was measured from the mid-height of the building. The theoretical pressure difference does not include any wind effect and represents the maximum pressure difference that could exist with zero flow.

Conclusions

It is evident from the curves of heat supply in Fig. 8 that it requires more heat to maintain the same room temperature on the lower floors of this building, for a given exposure, than it does on the upper floors. The difference in the amount of heat necessary to heat the 32nd floor test room is approximately 40 per cent less than that required to heat the 8th floor room when expressed on the same amount of exposed wall and glass.

THE GUIDE 1934 method of calculating the heat loss for the 8th floor, which is below the neutral zone, does not give values of heat quantities that compared with those obtained by these tests. The portion of this difference that is due to infiltration cannot be definitely stated at this time, but it is hoped that the future tests being planned will answer this question.

Three Codes Approved by Members

Three codes prepared by committees of the Society and discussed at Annual and Semi-Annual Meetings were submitted to the membership for vote by letter ballot. The report of R. B. Purdy, chairman of the Tellers, shows the following result:

1. A.S.H.V.E. Standard Code for Testing & Rating Return Line Low Vacuum Heating Pumps	FOR	180
	AGAINST	1
2. A.S.H.V.E. Standard Code for Testing & Rating Air Cleaning Devices Used in General Ventilation Work	FOR	175
	AGAINST	6
3. A.S.H.V.E. Standard Code for Testing & Rating Concealed Gravity Type Radiation (Hot Water Section)	FOR	170
	AGAINST	5

Total number of ballots—185.

Modernize If Return Justifies

In a recent address before the management division of the New York Real Estate Board, R. L. Hoguet, first vice-president of the Emigrant Industrial Savings Bank, New York, made the following recommendations: If it is believed, after careful investigation, that renovation will earn an income on the cost of the renovation without regard to the money already in the property, proceeding with the renovation is economically justified. If a building is structurally sound, it seems that if it is at all possible for the interests represented to finance the plans, the building should be modernized and made available at once.

Operating Results of an Air Conditioning System Compared with Design Figures

By **John R. Hertzler*, New York, N. Y.,**

(MEMBER)

PRIOR to 1932 and since 1926, the Union Dime Savings Bank had been satisfactorily ventilated by means of a supply and exhaust ventilation system of the central station type, installed with indirect vento-cast iron radiation for winter heating and unit type air filters for year-round cleaning of the air supplied for ventilation purposes. In spite of a large fan capacity and a rapid air change, inside summer conditions were not conducive to human comfort so that an air conditioning system, designed to provide year-round temperature and humidity control was installed, utilizing the existing ventilation system as far as practicable. The installation was made without interfering with the normal banking business in the spring of 1932 and has been in continuous operation since that time. Both the old and the new designs were prepared by Otto E. Goldschmidt, consulting engineer.

It shall be the purpose of this paper to describe the engineering calculations involved in the selection of the refrigeration equipment and to show in general a comparison of the test results and the theoretical analysis of the heat load conditions obtaining.

General Description of Building and Old Equipment

Prior to 1926, the bank building, Fig. 1, embraced a property approximately 100 ft square with an inside clear ceiling height of approximately 47½ ft, to which was added at that time, two floors of the adjacent office building, adding approximately 5,800 sq ft of floor area, 22 ft high. In the west side of this addition, a mezzanine level was created to include a director's room and a public room.

The original 10,000 sq ft of floor space with the 47½ ft high ceiling was ventilated by a separate supply and exhaust ventilation system complete with cast-iron radiation and air filters, direct radiation under thermostatic control supplementing the indirect heating for winter temperature control.

The construction of the building included five double glass windows each 25 ft high by 14 ft wide and a glass enclosed entrance vestibule with two revolving doors. The 6th Ave. Elevated Railway, east of the building, presented a noise and dirt problem, necessitating equipment and construction as outlined.

The west addition was a remodeled portion of the two lower floors of an adjacent office building and was ventilated by a similar supply and exhaust system.

Several basement rooms, including locker rooms, recreation room and the vaults were also supplied by the existing ventilation systems. The toilets were furnished with a separate exhaust system, discharging through the roof.

*Air Conditioning Engineer, York Ice Machinery Corp.

Presented at the Semi-Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Buck Hill Falls, Pa., June, 1934.

Selection of Air Conditioning Equipment

In estimating the heat load imposed on the building in the summer time, the usual calculations in accordance with standard practice, including sun effect on exposed wall area and roof space would be as follows:

Inside Temperature Conditions		Outside Temperature Conditions
80 F	Dry bulb temperature.	95 F
67 F	Wet bulb temperature.	75 F
50%	Relative humidity.	38 per cent
60 deg	Dew point.	66 deg
77.3	Grains of moisture per pound.	95.9
13.85	Cubic feet per pound.	14.29

Sensible Heat Load		Btu per Hr
North Wall	5500 sq ft × 0.25 U × (95 deg — 80 deg) =	20,600
East Wall	3630 sq ft × 0.25 U × (90 deg — 80 deg) =	13,600
Glass E. Wall	1150 sq ft × 0.45 U × (95 deg — 80 deg) =	1,770
South Wall	3650 sq ft × 0.25 U × (95 deg — 80 deg) =	13,700
Glass S. Wall	1550 sq ft × 0.45 U × (95 deg — 80 deg) =	10,500
West Partition	2176 sq ft × 0.3 U × (95 deg — 80 deg) =	9,800
West O. S. Wall	374 sq ft × 0.25 U × (95 deg — 80 deg) =	1,400
Ceiling under Office Bldg.	4000 sq ft × 0.3 U × (95 deg — 80 deg) =	18,000
Roof Old Bldg.	7728 sq ft × 0.26 U × (95 deg — 80 deg) =	30,100
Roof Addition	1800 sq ft × 0.28 U × (95 deg — 80 deg) =	7,560
Lighting	13600 watts × 3.415 Btu/watt hour =	46,400
Sun effect, S. Wall	3650 sq ft × 0.25 U × 25 deg =	22,800
Sun effect, Glass S. Wall	1550 sq ft × 0.45 U × 25 deg =	17,420
Sun Effect Roof	7728 sq ft × 0.26 U × 25 deg =	50,250
Sun Effect Roof, Add.	1800 sq ft × 0.28 U × 25 deg =	12,600
People	400 × 225 Btu/Hr/person =	90,000
Outside Air	$\frac{450{,}000 \text{ cu ft/hr} \times 0.24 \text{ Sp. Heat} \times (95-80)}{13.85 \text{ cu ft/lb}}$ =	117,000
Fan HP	15 Hp × 2545 Btu/Hp-Hr =	38,200
	Total Sensible Heat Load ..... =	527,700
	Btu/Hr or 44.0 Tons Refrigeration	

Latent Heat Load		Btu/Hr
People	400 × 175 Btu/Hr/Person =	70,000
Outside Air	$\frac{450{,}000 \text{ Cf/Hr } (95.9 \text{ Gr/lb} - 77.3 \text{ Gr/lb} \times 1060)}{13.85 \text{ Cf/lb} \times 7000 \text{ Gr/lb}}$ =	91,500
	Total Latent Heat Load..... =	161,500
	Or 13.5 Tons Refrigeration	

Total Refrigeration Requirements	
Sensible Heat Load by Calculations.....	44.0 Tons
Latent Heat Load by Calculations.....	13.5
	57.5 Tons
Chilled Water Pump Hp & Water Line Losses.....	5 Tons
	62.5 Tons

Neglecting the basement vault, locker room and recreation room which are relatively unimportant from the standpoint of heat gain, because of the negative effect of the ground, the calculations would show the necessity for installing a refrigerating plant having a capacity of 62.5 tons of refrigeration.

It is to be noticed in Fig. 2 however, that all air sup-

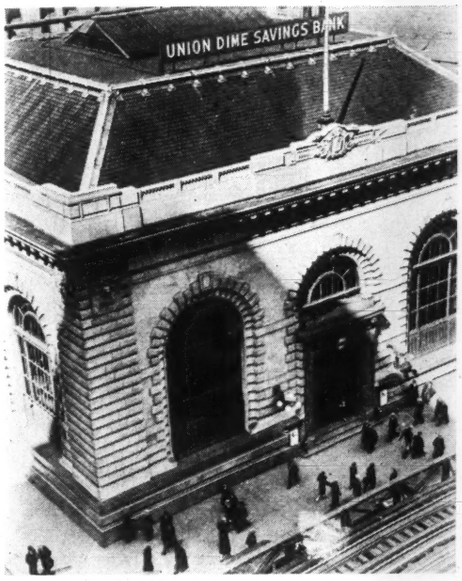


Fig. 1—Union Dime Savings Bank, New York

plied to the conditioned space is introduced through outlets not more than 8 ft above the floor line, above which point is the source of considerable of the heat gain. It would be expected that the upper portion of the 47 ft 6 in. high space in the old portion of the building could be stratified and could be considerably higher in temperature than the breathing zone, without causing any detrimental effects.

If the heat gain in the upper two-thirds of the main bank were neglected, the following deductions could be made from the sensible heat load as tabulated:

North Wall	13,800 Btu/Hr
East Wall	9,100 Btu/Hr
Glass E. Wall	3,885 Btu/Hr
South Wall	9,170 Btu/Hr
Glass S. Wall	5,250 Btu/Hr
Roof Old Bldg.	30,100 Btu/Hr
Chandelier Lighting	23,200 Btu/Hr
Sun Effect—S. Wall	15,300 Btu/Hr
Sun Effect—Gl. S. Wall	8,710 Btu/Hr
Sun Effect—Roof	50,250 Btu/Hr
Sun Effect—Roof Add.	12,600 Btu/Hr
	181,365 Btu/Hr
	= 15.1 Tons Refrigeration

These figures indicate that approximately 15 tons of refrigeration could be saved by introducing the air supplied for summer cooling within 10 ft of the floor line. This would be a net load of 47.4 tons of refrigeration, allowing for the same pumping and water line losses as originally suggested.

Type of Equipment Installed

The selection of refrigeration equipment installed was made primarily on the basis of the low operating cost and automatic operation afforded by a Freon water cooling system, furnished with a two-speed squirrel cage compressor-motor for automatic operation from the chilled water temperature supplied two air washers.

One air washer was furnished to operate with each of the main supply blowers. The exhaust fans were disconnected and a single supply fan was used to circulate the air in each of the two systems. With the added resistance, the large system was estimated to be capable of delivering 25,000 cfm and the small system—15,000 cfm. The amount of air passed through the air washers was limited to 10,000 cfm in system 1 and 6,700 in system 2.

The automatic summer control furnished, consisted of automatic operation of the spray nozzles in two-thirds of the cross-sectional area of each air washer—spray chamber for dry bulb temperature control and control of the spray water temperature by automatic refrigeration capacity regulation for humidity control.

Seasonal change-over thermostats were also provided to automatically throw the control of the chilled water and dehumidifier dewpoint temperature from the refrigeration system to automatic outside air volume dampers which operate to admit sufficient outside air for cooling

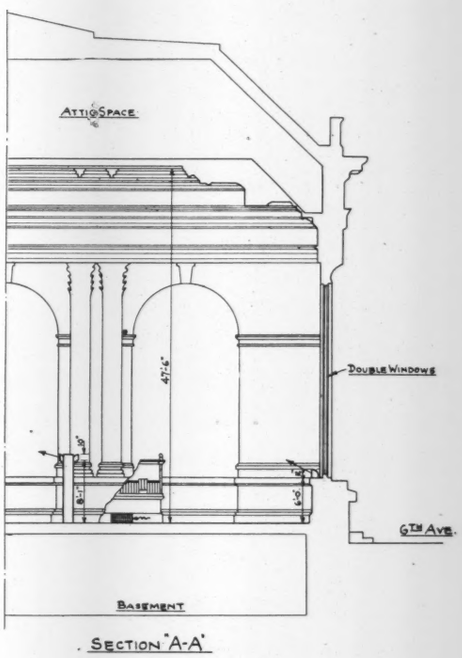


Fig. 2—Sectional View Showing Air Outlets

purposes when the outside air temperature is low enough. In this way, maximum economy of operation is obtained automatically.

Winter temperature control regulating steam supplied the reheater stacks to maintain a 70 F register temperature remained unchanged. The winter humidification is controlled from the dehumidifier dewpoint by regulation of the steam supplied closed water heaters in the chilled water connections at each dehumidifier.

The freon water cooling system as supplied, was 50-tons capacity, when cooling water as required to produce the specified maximum inside temperature and humidity conditions and when supplied with city water for condensing in an amount of 1¼ to 1½ gpm per ton of refrigeration.

The compressor was operated automatically by a two-speed squirrel cage motor 60 hp rating 1200-600 rpm; the machine starting, stopping and changing speed to maintain an approximately constant chilled water delivery temperature from the closed shell and tube water cooler. The operating cycle has been adjusted so that

capacity changes are automatically made on a 20 to 40 min interval. Under actual test, the efficiency of the compressor-motor at full speed was found to be 87 per cent and at one-half speed, 83 per cent. Since the square feet of evaporator surface and condensing surface per ton of refrigeration is doubled at one-half load, the kilowatt input of electrical energy per ton of refrigerating effect delivered is not increased but decreased for partial load operation of the refrigeration plant. It can be stated that for doubling the amount of condensing surface from 9 sq ft per ton to 18 sq ft per ton, the Bhp/ton in a Freon system of this kind would be decreased 9 per cent, the evaporating temperature remaining constant. For increasing the evaporator temperature 5 deg from 35 F to 40 F, the Bhp/ton would be decreased 9½ per cent, the condensing temperature remaining constant. The combined effect of doubling the condenser and evaporator surfaces per ton of refrigeration would therefore decrease the brake horsepower per ton 17.7 per cent, whereas the compressor-motor efficiency drops only 4 per cent for half speed operation.

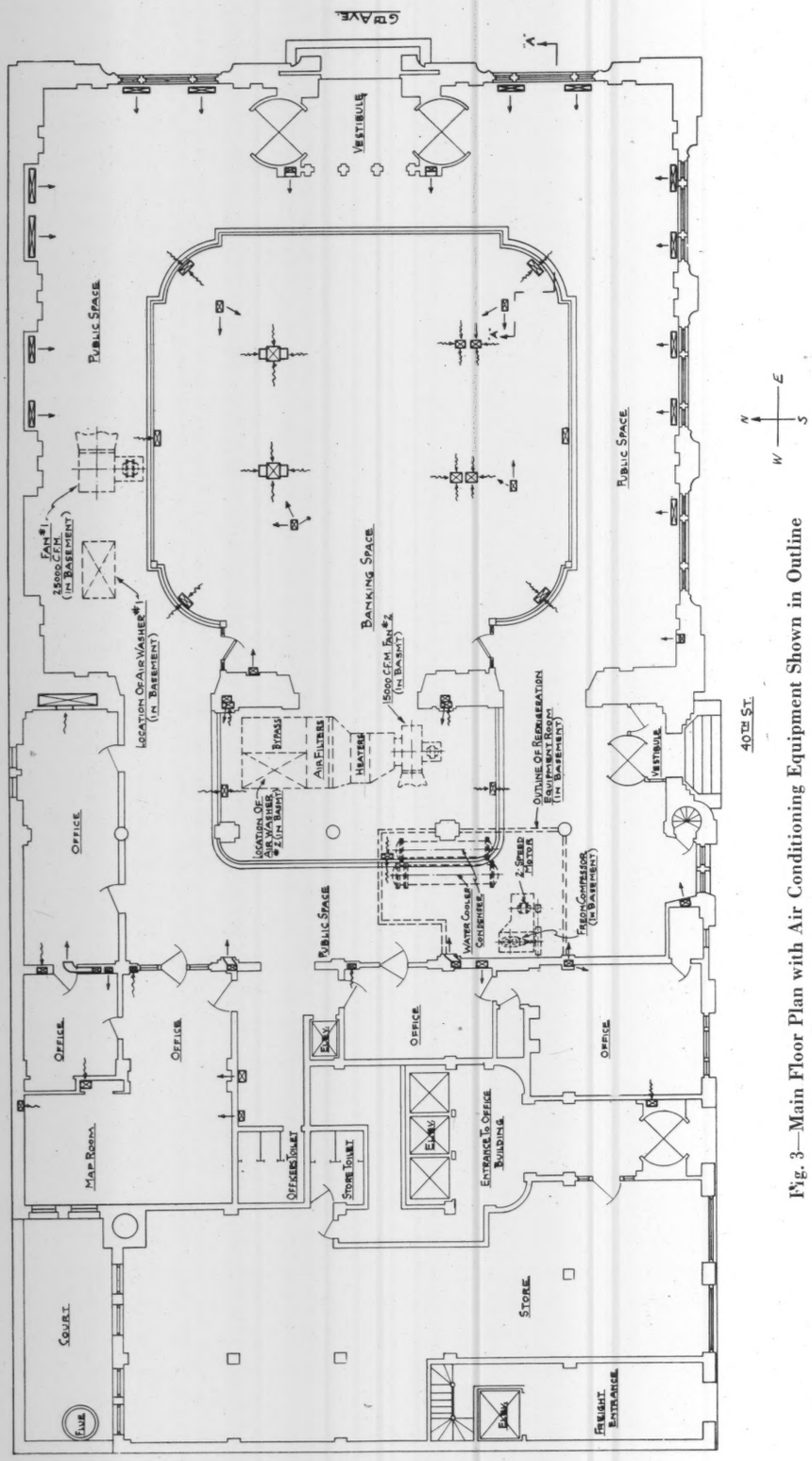


Fig. 3—Main Floor Plan with Air Conditioning Equipment Shown in Outline

In addition to the efficient speed control described, a manually operated capacity reducing bypass valve was furnished for each of the two compressor-cylinders, which permits of further capacity reduction to 25 per cent maximum capacity without an increase in full load kw—input per ton of refrigeration effect delivered. For one-half load at full speed, the compressor-motor efficiency was 82 per cent and for one-half load at one-half speed, the motor efficiency was 76 per cent. It has been found from experience that 25 per cent maximum capacity operation has not been required under the actual conditions of operation on the job, the normal start-stop, full speed, one-half speed control furnishing satisfactory operating cycles, even under operation at the smallest loads.

The condenser furnished was of the multipass horizontal closed shell and tube type, as indicated on the first floor plan, Fig. 3. The evaporator furnished was of the flash type, the liquid refrigerant being sprayed over the water tubes of the shell and tube cooler by means of a vertical liquid refrigerant recirculating pump.

The refrigeration system described was installed under the banking room as indicated in Fig. 3, the entire equipment being enclosed in a separate room, ventilated to the outside. The ceiling of this room was covered with an acoustical material to prevent the possibility of any mechanical noises being transmitted to the office space above.

The air washer arrangement outlined on Fig. 3, shows the air filters in series with the air washer. In the rearrangement of the air filters on system 1—in order

to equalize the air resistance, the filter sections were installed in the bypass or recirculating connections to the fan and in the outside air intake. On this system, the return air passing through the air washer is not filtered.

Air conditioning systems are seldom called upon to operate under design conditions but it so happened that July 1, 1932, at the beginning of a quarter, a busy banking day, provided maximum outside temperature and humidity conditions as can be noted from Table 1.

Table 1—July 1, 1932

	Time	9 A. M.	10 A. M.	12 M.	1 P. M.	2 P. M.	4 P. M.
Outside Temp. Degrees	DB	78.4	84.5	90.0	89.5	91.5	91.0
	WB	69.4	78.0	75.9	76.5	76.5	78.0
Inside Temp. Degrees Sta. (1)	DB	75.8	76.6	77.5	78.3	79.0	77.5
	WB	66.0	66.0	67.8	68.0	68.5	65.5
Inside Temp. Degrees Sta. (2)	DB	75.6	76.0	77.8	78.0	78.5	77.3
	WB	65.8	65.5	67.3	66.9	67.5	65.3
Inside Temp. Degrees Sta. (3)	DB	76.3	76.3	78.1	77.3	78.0	78.0
	WB	66.0	65.5	67.3	66.8	67.0	66.1
Inside Temp. Degrees Sta. (4)	DB	76.0	76.5	77.5	77.8	78.2	78.0
	WB	66.0	66.0	67.0	66.6	66.8	66.3
Inside Temp. Degrees Sta. (5)	DB	75.8	76.0	77.5	78.2	78.7	78.0
	WB	66.3	65.0	67.0	67.0	67.3	66.0
Air Out Wash. Degrees No. 1	DB	55.0	56.8	58.6	58.5	57.3	57.5
	WB	54.7	56.4	58.0	58.0	57.0	57.0
Air Out Wash. Degrees No. 2	DB	52.8	53.7	56.3	56.2	57.2	55.0
	WB	52.5	53.5	56.0	55.8	57.0	54.2

No. of people in Bank—300-400 all day.
Sta. (1) North Side Old Bldg.
Sta. (2) South Side Old Bldg.
Sta. (3) North Side New Bldg.
Sta. (4) South Side New Bldg.
Sta. (5) Center of Banking Space.

For measuring the refrigeration effect, plate orifices were installed in both the chilled water circuit and the condensing water circuit for measuring the quantity of water in circulation, and temperatures of the water in and out of the condenser and water cooler were recorded regularly to complete the check.

The figure used for tonnage by condenser water readings was 30 gal degrees per minute per ton or 250 Btu min per ton.

For the 12 noon readings, the refrigeration capacity by chilled water measurement was 36.1 tons; by condensing water measurement 37 tons. At 1 p. m. the refrigeration by chilled water was again 36.1 tons; by condensing water 35.8 tons.

For the 2 p. m. and 4 p. m. readings, the refrigeration load by chilled water measurement was 43.5 tons; by condenser water measurement 42.4 tons at 2 p. m., 41.3 tons at 4 p. m.

The figures cited check quite well and prove quite definitely that the upper section of such a building can be stratified in a summer cooling proposition of this nature.

The quantity of outside air admitted for ventilation was rather definitely established by measurement on the outside air intakes and by the capacity of the toilet exhaust systems and the remainder of the factors considered in the calculations were all rather close to the assumed maximums.

The inside temperature and humidity conditions were below the guaranteed calculated figure of 80 F and 50 per cent relative humidity and during the afternoon operation, the outside dry bulb temperature ranged from 89.5 F. to 91.5 F.; for outside wet bulbs from 75.9 F. to 78 F.

The small difference in simultaneous inside temperature readings shows the effectiveness of the air distribution, the maximum variation in the various readings at five stations ranging from 0.5 F to 1 F on both dry bulb and wet bulb temperatures.

With a sensible heat load in the conditioned space of 22-tons which allows for 150,000 cf/hr of infiltration direct to the bank, 40,000 cfm of supply air would be warmed through a range of 6.2 F which further indicates that the supply air at the outlets to the bank would be 73.8 F, while maintaining an 80 F inside temperature. This, of course, is considerably more fan capacity than is recommended for a new installation, but being available, it has been used during a considerable portion of the operating period. The supply fans are equipped with direct connected direct current fan motors provided with field control for adjustable speed operation, offering considerable operating flexibility. The fans during summer operation are run at a fixed speed determined for velocity air distribution from the supply outlets. In the winter time, much less air movement inside the bank is desirable so that the fans are then operated at lower speeds, at the discretion of the operators.

Compressor Operation Period

The operating cycle of the compressor will be duplicated somewhat as tabulated in Table 2 for an average day.

Table 2—Aug 30, 1932

High Speed Operation		Low Speed Operation	
Time	Minutes Operation	Time	Minutes Operation
8:05-8:45	40	8:45-9:14	29
9:14-9:32	18	9:32-10:03	31
10:03-10:21	18	10:21-10:52	31
10:52-11:10	18	11:10-11:39	29
11:39-11:59	20	11:59-12:25	26
12:25-12:45	20	12:45-1:11	26
1:11-1:31	20	1:31-1:57	26
1:57-2:17	20	2:17-2:43	26
2:43-3:03	20	3:03-3:08	5
	194 Min		229 Min
	3 hr 14 Min		3 hr 49 Min

Total Operation .....194 Min @ High Speed
229 Min @ Low Speed
423 Min or 7 hr-3 min
High Speed Operation—45.9 per cent
Low Speed Operation—54.1 per cent

This method of operation, automatically accomplished has proven very satisfactory with unusually fine conditions being obtained on operating cycles as indicated.

Operating Costs

Based on a 50 per cent load factor, the power and water costs were predicted within an accuracy of 5 per cent, however, there are several interesting phases of the operating cost of the equipment which can be applied quite frequently in the case of institutions of this type.

First, the fan horsepower after the installation of an air conditioning equipment, was reduced because the old exhaust fans, operated previously in the supply and exhaust ventilation system, were shut down for 12 months of the year. This power saving over 12 months was found to be more than the cost of the power used by the refrigeration plant for four months of the year.

Second, the installation of air washers with facilities for additional cleansing of the air permitted recirculation of a large portion in the winter time, only sufficient outside air being introduced to balance the toilet exhaust system and to provide adequate ventilation. Because of the smaller amount of outside

air introduced in the winter time, a definite steam saving was made, the amount of which more than offset the cost of the city water used for condensing purposes in the refrigeration system.

From the records of the bank the cost of power purchased in 1931 was $6,195.60 and in 1932, only $6,274.16 or an increase of $78.56 for air conditioning.

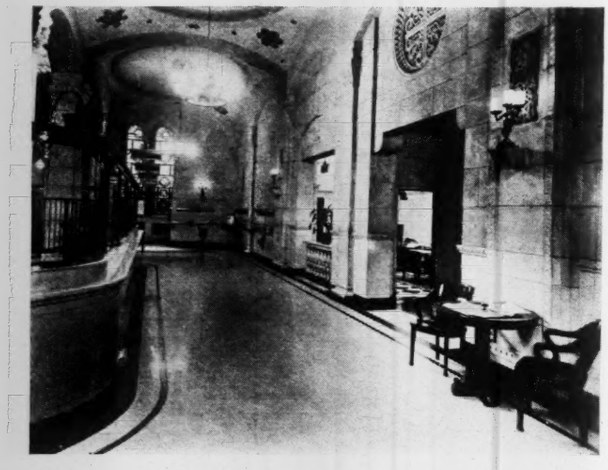


Fig. 4—Interior View, West Addition, Looking South

The cost of steam in 1931 was $2,716.62, and in 1933, the first full 12 months with air conditioning $2,059.28, representing a saving in steam cost of $657.34 for the year or of about 25 per cent, due to recirculation. These figures may vary somewhat from year to year as the records show the cost of steam in 1929 as approximately $2,000.00 and in 1930 as approximately $2,500.00, but the principle of the recirculation will always provide a definite saving.

In 1931, the additional water used for condensing cost approximately $400.00, so that the steam saving and slight power increase still show a net saving after air conditioning of approximately $200.00 per year in operating cost.

No additional help was hired to operate the plant because of its classification as a Class B automatic refrigerating system—having less than 1,000 lb of refrigerant charge.

The air conditioning cost on this installation was then only the interest depreciation and obsolescence charges, usually approximately 15 per cent of the first cost per annum which is economical, to say the least.

The benefits of winter humidification have reduced absences due to sickness and in general, the improved atmosphere has been conducive to good business and better spirit on the part of both customers and employees the year 'round.

Conclusion

In conclusion, it is to be noted that this air conditioning installation—supplementing an existing supply and exhaust ventilation system—

(1) Was installed to utilize the existing ductwork and supply fans, thus greatly reducing the first cost of the installation and eliminating architectural changes in the banking interior.

(2) Stratified the upper portion of a high ceiling space during summer operation, reducing both the first cost and operating cost of the equipment as required.

(3) While maintaining automatically inside atmospheric conditions, at all times within the zone of comfort, reduced the operating cost below that of a supply and exhaust ventilation system which did not provide summer cooling or winter humidifying furnished by the air conditioning system.

That these principles can be applied to other applications, there can be no doubt, and if full inventory of all such cases is made, it is likely that the ever mounting advantages of air conditioning will become even more evident than is the case today.

Silicosis Reference Volume Issued

Pneumonokonioses (Silicosis) — Bibliography and Laws is an exhaustive compilation of the references to the pneumonokonioses (silicosis) in the literature of the world and has been compiled by George G. Davis, M.D., F.A.C.S., Associate Clinical Professor of Surgery, Rush Medical College, University of Chicago; Attending Surgeon, Cook County Hospital; Ella M. Salmonsen, Medical Reference Librarian; and Joseph L. Earlywine, of the Chicago Bar, with foreword by E. R. Le Count, M.D., Professor and Chairman, Department of Pathology, Rush Medical College, University of Chicago. Several years of research make this bibliography complete and up to date.

Scores of industries have spent large sums of money for hurried, and necessarily only partial, surveys of the literature of silicosis; and numerous medical men have felt the need of a more complete list of references than any heretofore available to them. This volume covers the entire subject; the book contains every available reference to the pneumonokonioses (silicosis) in the literature of the world, from the first reference in point of time of publication, in Agricola's "De re metallica," in 1556, to the last published articles in 1933. The standing of the compilers in their respective professions—medical, library, and law—gives their joint effort a highly authoritative importance.

The book has two sections. The first is the Bibliography, which is followed by a subject index, an authors' index and a reference-year index and an index of reference headings. The second is the Law, containing a summary of the occupational disease laws, workmen's compensation laws and common laws of the states of the United States, together with decisions as they relate to the pneumonokonioses (silicosis). The law summary is followed by an index of states and an alphabetical index of the cases. Among the original features of this book are, first, an exhaustive cross-indexing, and, second, a size and arrangement of typography conducive to quick and easy reading.

The compilers and the publishers intend to issue supplemental volumes for successive years; the first supplement to appear shortly after January 1, 1935, to cover all the published references of 1934, with the more important references annotated.

Physicians and surgeons, lawyers, industrial executives, insurance officials, medical and public libraries, industrial boards and state commissions, journalists, engineers, writers, and research workers will find this book indispensable.

This volume is published by Industrial Medicine, Inc., 844 Rush St., Chicago, Ill., size 6 x 9, bound in cloth, and is available at $7.50 a copy.

Proceedings of the Semi-Annual Meeting 1934

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Buck Hill Falls, Pa. The Inn

WITH members and guests in attendance from 17 states, the District of Columbia, and Canada, totalling nearly 300, the 1934 Semi-Annual Meeting of the Society was held at The Inn, Buck Hill Falls, Pa., June 19-22. In addition to the usual technical sessions, an innovation was introduced in the form of non-technical addresses by nationally known men in the construction field and these discussions relating to the rehabilitation of the construction industry were enthusiastically received.

One of the three technical sessions was held jointly with the members of the *American Society of Refrigerating Engineers* and four papers were presented and discussed by the members of both societies.

Amendments to the Society's Constitution were introduced and discussed, then favorable action was taken on two changes in the By-Laws previously mailed to members of the Society.

R. C. Bolsinger was General Chairman of Arrangements and he was assisted by the following committee chairmen: W. P. Culbert—Golf Tournament, M. F. Blankin—Banquet, W. R. Eichberg—Entertainment, M. C. Gillett—Ladies, Harry Black—Registration and Reception, J. H. Hucker—Transportation and Publicity, and W. F. Smith—Finance.

Registration began on Tuesday morning, June 19, and during the day meetings of the Guide Publication Committee and the Committee on Research were held. In the evening members of the Council attended a dinner and meeting at which 1935 meeting places were selected, five members were nominated for service on the Committee on Research and other routine business was acted upon.

FIRST SESSION—

Wednesday, June 20, 9:30 A. M.

Pres. C. V. Haynes presided at the opening session and responded to the greetings of W. P. Culbert, president of the Philadelphia Chapter, who expressed the pleasure of the members acting as hosts for the large attendance.

The first paper, Criteria for Industrial Exhaust Systems, by J. J. Bloomfield, sanitary engineer, Bureau of Public Health, Washington, D. C., was presented by the author. (Published in *Heating, Piping and Air Conditioning,* July, 1934). This paper proved to be deeply interesting to the group present and J. J. Aeberly, R. P. Cook, and N. D. Adams were among those taking part in the discussion.

Dry-Bulb vs. Effective Temperature Control was the title of the second paper, read by the author, A. E. Beals, Norwich, N. Y. (Published in *Heating, Piping and Air Conditioning,* July 1934). This presentation, commenting on research work of the Society, resulted in considerable discussion by F. C. Houghten, W. H. Carrier, W. L. Fleisher, and F. C. McIntosh.

At the request of Prof. Axel Marin, associate professor of mechanical engineering, University of Michigan, who was called home while en route to the Society's meeting, J. H. Walker presented his paper on Influence of Stack Effect on the Heat Loss in Tall Buildings. (Published in *Heating, Piping and Air Conditioning,* August, 1934). Detailed results of investigations made in the Penobscot Building, Detroit, Mich., in cooperation with the Technical Advisory Committee on Heat Requirements of Buildings, were reported and some comments were offered by D. S. Boyden, chairman of the committee.

F. C. Houghten, director of the A. S. H. V. E. Research Laboratory, was introduced by President Haynes and gave an abstract of the paper Wind Velocities Near a Building and Their Effect on Heat Loss, of which J. L. Blackshaw and Carl Gutberlet are co-authors. (To be published in *Heating, Piping and Air Conditioning,* September, 1934). As a research project under the direction of the Technical Advisory Committee on Heat Requirements of Buildings, studies were made in eight individual rooms in the Grant Building, Pittsburgh, and the data collected were of great interest to the members. Comments were made by W. C. Randall, J. H. Walker, G. D. Winans, W. L. Fleisher, W. W. Timmis and D. S. Boyden.

At the conclusion of the technical program, Pres. Haynes said that the Society had suffered a grievous loss and requested the members to stand with bowed heads as a tribute to the late Dean F. Paul Anderson. J. I. Lyle presented the following resolution in memory of Dean Anderson, past president of the Society and former Dean of the University of Kentucky College of Engineering, who died on April 8, 1934:

WHEREAS God in his wisdom has seen fit to take from our midst our beloved past president, Dean F. Paul Anderson,

WHEREAS the Society has been immeasurably benefited by his wise counsel and unfailing endeavors to further its best interests,

WHEREAS his organizing ability and leadership in promoting the work of the research laboratory was outstanding, and

WHEREAS his accomplishments in the academic world reflected credit to his University and this Society,

WHEREAS his most genial personality, genuine comradeship and real sympathy for others endeared him to all our members and his associates

THEREFORE, be it RESOLVED, that the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS hereby expresses its sense of bereavement and irreparable loss; and be it further RESOLVED, that this resolution be inscribed in the proceedings of the Society and a copy be sent to his family.

A motion by W. T. Jones, seconded by J. D. Cassell, that this resolution be adopted was passed by vote of the meeting.

Col. Chevalier Speaks at Luncheon

Before closing the session, President Haynes announced that at luncheon immediately following, Society members and guests would have the pleasure of hearing Col. Willard Chevalier, of McGraw-Hill Publishing Co., who would speak on Examining the Construction Recovery Program.

W. H. Driscoll presided at the Get-Together Luncheon in the main dining room and presented the guest and speaker. Colonel Willard Chevalier, speaking from wide experience and understanding, analyzed the economic problems facing the construction industry and foresaw a definite trend toward better business. A fluent and forceful speaker, Colonel Chevalier was enthusiastically received by the A. S. H. V. E. group.

SECOND SESSION—
Thursday, June 21, 9:30 A. M.

A joint meeting with the *American Society of Refrigerating Engineers* was presided over by W. H. Carrier, past president of both organizations. In opening the session Mr. Carrier greeted the members and welcomed the *A. S. R. E.,* whose interests in air conditioning are closely identified with the Society, and presented the following officers of both societies who were present: Dr. A. R. Stevenson, Jr., Schenectady, N. Y., president of the *A. S. R. E.,* and Harry Harrison, New Brunswick, N. J., vice-president; C. V. Haynes, Philadelphia, Pa., president of the A. S. H. V. E., John Howatt, Chicago, Ill., 1st vice-president, G. L. Larson, Madison, Wis., 2nd vice-president, and D. S. Boyden, Boston, Mass., treasurer.

A telegram of greetings from the Institution of Heating and Ventilating Engineers, Great Britain, was read, after which the authors of technical papers were presented.

The *American Society of Refrigerating Engineers* was responsible for two technical presentations and the first paper by Paul Bancel, New York, N. Y., discussed the subject of The Water Vapor Centrifugal Compressor.

D. W. McLenegan, a member of both organizations, was introduced by Mr. Carrier and described Electric Rate Making for Small Air Conditioning Units.

A five minute intermission was declared and President Haynes took the chair. He expressed pleasure at having Thomas S. Holden, vice-president in charge of statistics and research of F. W. Dodge Corp., as a guest and speaker. Mr. Holden, who is nationally known in the architectural and building construction field and who holds many civic offices, was presented by President Haynes and spoke on The Reemployment of the Construction Industry. (For complete text, see next page.)

At the conclusion of Mr. Holden's talk, Mr. Carrier resumed the chair and the first A. S. H. V. E. paper on Operating Results of an Air Conditioning System Compared with Design Figures was given by the author, J. R. Hertzler. (Published in *Heating, Piping and Air Conditioning,* August, 1934.) Comments on this presentation were offered by D. W. McLenegan, Paul Bancel, and Mr. Carrier.

John Everetts, Jr., presented the final paper of this session entitled What is the Cooling Load Factor in Air Conditioning? (To be published in *Heating, Piping and Air Conditioning,* September, 1934.) Discussion was given by W. L. Fleisher and W. H. Carrier, after which the meeting was adjourned.

Secretary, AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, The Inn, Buck Hill Falls, Pa.

Fraternal greetings and best wishes for success of your meetings from summer meeting of *Institution of Heating and Ventilating Engineers England.*

CHING, *President.*

Re-Employment of the Construction Industry*

By Thomas S. Holden†

THE construction industry need not base its claim for re-employment on mere reiteration of the story of its sad decline from a total volume of $9,000,000,000 in 1928 to less than $2,000,000,000 in 1932 and in 1933. Its claim for re-employment to full capacity is based on three basic facts: (1) Building and engineering works of many kinds are needed; (2) A construction program offers the best method of re-employing directly and indirectly all the able workers of the nation; (3) Sound improvements afford the best field of investment for our unemployed capital and credit resources.

Owing to surpluses of certain particular types of buildings and to the financial difficulties experienced by their owners and mortgagees, it has been frequently stated in the past five years that the country is overbuilt. It has not been realized that the United States is far-more jerry-built than over-built. This country has yet to create a truly civilized environment for all its people. In order to do so it is now in process of creating a new kind of construction program.

It has become obvious that a new kind of construction program was necessary. Until quite recently the principal factor in creating construction demand was population increase. This not only created most of the demand for new housing, but it was also the basis of city-growth and the expansion of public services and utilities, real estate speculation, and many manifestations of industrial and commercial expansion. The last census decade, which had the largest construction volume on record also had the largest numerical increase in population, 17,000,000 new people. It is now estimated that the increase during the current decade will run from 7,000,000 to 9,000,000 people. Taking this into account, and also taking into account the great reduction in national income that has taken place since 1929, it is reasonably estimated that reliance upon the old speculative stimuli alone would give us a total construction volume from 1930 through 1939 amounting to just about half the volume the industry had between 1920 and 1929. That would hold out the hope of re-employment from the 20 per cent capacity basis of last year about up to 50 per cent capacity. If that were all the industry and the country could look forward to, it would probably mean a stabilization of national income and of living standards at something just a little better than we have today.

It is probably incorrect to assume, as most of us have been doing, that the big construction boom of the years 1925-1929 collapsed because it was too big. It collapsed because it was not based on sound economic demand and because it was accompanied by the most colossal mismanagement of credit that we have ever seen. We built too many of the wrong kinds of things in the wrong places. For example, if it had been possible to substitute for the surplus hotels and de luxe apartments and office buildings that were built in New York City a big program of improvement of the East River water-front (which is almost entirely blighted) the same amount of money could have been wisely spent, employment might have remained steady, many New York properties could have been saved from financial distress, and a large area of the city might now be on the upgrade instead of on the downgrade. Skyscrapers were built, not because they were needed, but because the security houses wanted to sell bonds. The construction industry had a planned economy, with security salesmen doing the planning.

The $70,000,000,000 construction program of the decade 1920-1929 gave this country a great deal more than the financial head-ache that came at the end of the boom. At least 55 out of the 70 billions was in response to a sound economic demand. Revival of construction in 1921 furnished the initial motive power to the expansion of the automobile industry and of the electric power industry. The program gave the country a vastly improved highway system, an improved industrial plant capacity, and many other physical improvements the use of which we have today. It also provided the initial motive power for raising the national income from $53,000,000,000 in 1921 to $83,000,000,000 in 1929. This increase in income actually meant that average per capita spending power during the 1920-1929 decade was 30 per cent greater than in the preceding decade. It remains to be seen whether the New Deal can produce as big a construction program as the New Era did, and at the same time produce a sounder program that will not collapse in a speculative orgy. There are reasons to hope that it may.

The principal measures adopted to date by the Federal Administration that are of vital importance to the construction industry are: (1) The public works program; (2) The Tennessee Valley project; (3) The National Housing Act; (4) The real property inventories.

The public works program has been so thoroughly reported in the press that little needs to be said about it. It caused the total of publicly financed projects to increase during the first five months of this year 274 per cent over the corresponding months of last year, while privately financed work increased 17½ per cent. Congress has just granted an additional half billion for public projects, so that some provision has been made for continuation. Very important in the public works section of the National Industrial Recovery Act was the provision for setting up the National Planning Board. This Board is scheduled to make its report next Autumn, with recommendations as to long-range public works policies, city and regional planning and similar matters of great significance for the future of construction. The Act also included provision for low-cost housing and slum-clearance projects, a feature that has not yet been worked out to complete success but which has dramatized to the nation the need for a housing policy.

The Tennessee Valley project is an experiment in regional planning which may be of tremendous value in guiding future development of large areas of the country.

The National Housing Act is something more than an emergency expedient to stimulate repair and modernization work and new owner-occupied homes. It seeks to establish the 20-year amortized first mortgage as the standard method of home-financing, to eliminate the second-mortgage, to make mortgage funds liquid, to make home-mortgage investments attractive, and ultimately to reduce mortgage interest rates. With this new measure added to the Federal Home Loan Bank System and the Home Owners' Loan Corporation, the country is definitely on the way toward securing a national mortgage banking system, which it has long needed and which practically every other civilized country has had for many years.

The real property inventories, which were undertaken early this year as civil works projects under the auspices of the Bureau of Foreign and Domestic Commerce, were surveys made in 63 cities all over the country. A sixty-fourth city, New York, made a similar survey as a local civil-works project. These inventory reports are giving us, not only a measure of present housing shortages and surpluses, but a more comprehensive body of information on American housing standards than we ever had before. They indicate the method by which economic demand may be determined, credit may be wisely administered, and cities wisely planned. For the first time the industry can work toward supplying the demand for a market that is reasonably well known.

So far, 42 cities have been reported. In 28 out of the 42, the number of resident families exceeds the number of dwelling units rated as fit for use. Nineteen per cent of the occupied housing units in the 42 cities are reported as crowded or overcrowded, and the extra families doubled up exceed the numbers of vacant units.

Overcrowding is not the only indication of poor housing

*Address made before Joint Session of *American Society of Refrigerating Engineers* and American Society of Heating & Ventilating Engineers, June, 1934.

†Vice President, F. W. Dodge Corp.

standards. These 42 cities have 627,143 residential structures containing a total of 780,646 family dwelling units. Of these structures, 44 per cent are in need of minor repairs, 16½ per cent need structural repairs, and 2½ per cent are rated as unfit for use. At least half of the dwelling units are such as would rent today for less than $21 a month; 10 per cent are without running water; 22 per cent are without private indoor water-closets; 28 per cent are without bath tubs or showers; 13 per cent are without gas or electricity for lighting; 69 per cent are without central heating; and 83 per cent are without mechanical refrigeration. Since the need for central heating varies with climate, it is well to differentiate between the north and the south. Even in the 21 northern cities, 37 per cent of the dwelling units are without central heating; while 86 per cent of the southern family units lack this desirable facility. While these figures are not final they may be taken as fairly typical indications of housing standards in the smaller cities of the country. There can be no argument as to the need for new housing, for repairs and modernization, or for raising housing standards. The limitations on the volume of such work that may be possible are not lack of need, but present low incomes of great masses of people.

There is also in these reports one clear indication that the market for repairs, modernization and new housing is going to depend on keeping construction costs down. There is in the 42 cities garage capacity for 534,317 cars and only 418,523 cars owned. Garage vacancies are double the housing vacancies. Restored incomes of these families may lead more readily to buying cars than housing improvements unless the purchaser can get something near as good value for his housing money as he gets for his automobile dollars.

We have in this country not only jerry-built housing, but also jerry-built cities, inadequately planned, with large areas blighted or deteriorated into slums, inefficient as to traffic movements, embarrassed financially, and losing some of their best population to the surrounding suburbs and country-side. Parks and recreation centers to hold the population and arrest real estate deflation are essential. Grade crossing eliminations, motor parkways, water-works and sewer systems, power plants and dozens of other kinds of improvements are urgently needed in many places. Last January Public Works Administrator Ickes announced that, after all the original $3,300,000,000 of the public works fund had been allotted, there will still be applications before him for projects totaling $3,500,000,000. During the past 12 months F. W. Dodge Corp. has reported for the 37 states east of the Rocky Mountains contemplated new building and engineering projects to the amount of $6,600,000,000, which is a little more than four times the amount of contracts awarded in the same period. In view of all these facts it is readily seen that the potential demand for construction is very considerably greater than the current rate of activity.

A beginning has been made toward directing idle investment funds into the channels of construction. In both private and public construction financing, loans on the basis of low interest rates and as high a rate of amortization as possible should provide safe investments and at the same time ample facilities for financing all construction that is actually needed. We financed the biggest war we ever engaged in on credit; bad credit it turned out to be because it was used to destroy the means of paying back the loans. We financed the biggest construction boom in history on credit; that credit turned sour, too, because it was managed by speculators who had little care as to whether the loans could be amortized out of the income of the properties, so long as there was a profit in the sale of the securities. There seems to be no real reason why we can not develop a sound credit mechanism for long-term investments that will be adequate for all the legitimate needs of the country. We have in this country the man-power, the material resources, the technique and the capital and credit resources to create here a civilized America in place of the jerry-built America we have. Such a program wisely planned and soundly administered, might quite conceivably re-employ the construction industry to its full 1928 capacity, instead of the 20 per cent capacity basis of 1932 and 1933, the 30 or 35 per cent capacity basis of 1934, or the 50 per cent capacity basis for this decade which is about the best we would get if we were not creating new kinds of programs, new investment concepts, and new credit-mechanisms to meet the changed requirements of today.

Construction has proved itself the best way of putting men to work, stimulating business and raising incomes. So long as able workers remain unemployed, so long as sound improvement projects remain undone, and so long as capital funds remain idle, our credit system is inefficient, just as it was inefficient in other ways in 1929. Proper management of credit has its creative functions to perform as well as its restrictive functions.

It would be perfectly possible to spend 4 to 5 billion dollars annually for the next 20 years on housing alone, to make necessary repairs on buildings worth spending money on, to replace those now unfit and those that will reach that stage, and to provide every family with a minimum of conveniences for adequate space, light, heat and sanitation. The public improvements that would go with such a housing program, together with commercial and industrial developments that would result from it could easily use another 4 or 5 billion a year. Such expenditures, managed as wisely as we might learn to manage them, would not only re-employ the construction industry, but would lift the national income back to what it was in 1929, and, we hope, might keep it there. Such an objective has to be attained gradually, and painstakingly, and on the basis of sound investment in America's well-being, not speculation on America's future.

THIRD SESSION—

Friday, June 22, 9:30 A. M.

The closing period of the 40th Semi-Annual Meeting of the Society was declared in session by Pres. C. V. Haynes, who announced that the registration of members, guests and ladies was unusually large for a summer meeting and he expressed his appreciation for the attendance.

The first item of business was a report on amendments to the Constitution and By-Laws, which was presented by W. T. Jones. The proposed changes in the Constitution which were endorsed by the Council, were as follows:

Article C-II, *Section* 7. A Student Member shall be a person over sixteen (16) years of age who is regularly attending courses in an engineering college or school.

To Be Amended as Follows: A Student Member shall be a person *between the ages of 20 and 25 years,* who is regularly attending courses in an engineering college or *technical* school *at the time of applying for membership.*

On motion of W. T. Jones, seconded by J. D. Cassell, it was

VOTED: THAT the proposed amendment be accepted and sent out to the membership for ballot in the prescribed manner.

Article C-III, *Section* 4. When a Student Member discontinues his regular studies in an engineering college or school, it shall be incumbent upon him to apply within one (1) year for advancement to either Junior, Associate or Member grade.

To Be Amended as Follows: When a Student Member discontinues his regular studies in an engineering college or technical school, it shall be incumbent upon him to apply within one (1) year for advancement to either Junior or Associate grade. *In no case shall the period of Student Membership exceed four (4) years.*

On motion of W. T. Jones, seconded by R. H. Carpenter, it was

VOTED: THAT the proposed amendment be approved by the meeting and be sent out to the membership for ballot in the prescribed manner.

Amendment on Dues Adopted

The following amendments to the By-Laws sent to the membership in advance of the Semi-Annual Meeting were read by Mr. Jones:

Article B-IV, *Section* 1. The Admission Fee of Members, Associate Members, Junior Members and Student Members shall be as determined by the Council until 1935 and thereafter the admission fee of Members and Associate Members shall be fifteen dollars ($15.00); of Junior Members five dollars ($5.00); and of Student Members two dollars ($2.00). Admission fee must accompany application.

To Be Amended as Follows: The Admission Fee of Members, Associate Members, Junior Members and Student Members shall be as determined by the Council until *1940* and thereafter the admission fee of Members and Associate Members shall be fifteen dollars ($15.00); of Junior Members five dollars ($5.00); and of Student Members two dollars ($2.00). Admission fee must accompany application.

On motion of W. T. Jones, seconded by R. H. Carpenter, it was

VOTED: THAT the amendment be adopted.

Article B-IV, *Section* 2. The annual dues of Members, Associate Members, Junior Members and Student Members shall be as determined by the Council until 1935 and thereafter the dues of Members and Associate Members shall be twenty-five dollars ($25.00); of Junior Members twelve dollars ($12.00); and of Student Members three dollars ($3.00).

To Be Amended as Follows: The annual dues of Members, Associate Members, Junior Members and Student Members shall be as determined by the Council until *1940* and thereafter the dues of Members and Associate Members shall be twenty-five dollars ($25.00); of Junior Members twelve dollars ($12.00); and of Student Members *five dollars ($5.00)*.

On motion of W. T. Jones, seconded by A. W. Luck, it was

VOTED: THAT the amendment be adopted.

Mr. Jones explained that an amendment to Article B-VIII—Committees, *Section* 1, had been proposed during the 40th Annual Meeting of the Society in New York and had been referred to the Committee on Constitution and By-Laws. The committee had considered the matter and had not approved of the proposal to change the present Article and permit appointment of other than Council members on the Executive, Finance, Membership and Meetings Committees as it felt that these committees should be chosen from the Council whose members are elected by the Society.

On motion of W. T. Jones, seconded by R. H. Carpenter, it was

VOTED: THAT the proposed amendment to Article B-VIII, Section 1 of the By-Laws be rejected.

A new *Section* 11, of Article B-VIII, prepared by the Committee on Constitution and By-Laws and amended by Council is proposed as follows:

Section 11. At the first meeting of the Council after the Annual Meeting, or as soon thereafter as possible, the president shall appoint a Committee of at least five (5) members, whose duty it shall be to arrange for the publication of The Guide. This Committee shall be responsible for the text section and shall arrange for the inclusion of such new chapters as will furnish information regarding new developments.

In order that the wording of the various Sections of Article B-VIII may be in agreement, the Council suggested a change in the wording of the present *Section* 11, which would become *Section* 12:

Section 11. At the organization meeting of the Council, each year, the president shall appoint a Committee of five (5) members to be known as the F. Paul Anderson Award Committee. This Committee shall function according to the terms of the F. Paul Anderson Award. (See Appendix B.)

To Be Amended as Follows: Section 12. At the first meeting of the Council after the Annual Meeting or as soon thereafter as possible, the president shall appoint a Committee of five (5) members to be known as the F. Paul Anderson Award Committee. This committee shall function according to the terms of the F. Paul Anderson Award. (See Appendix B.)

On Motion of W. T. Jones, seconded by J. D. Cassell, it was

VOTED: THAT these amendments to the By-Laws be sent to the members of the Society in the prescribed manner.

At the conclusion of discussion on amendments to the Constitution and By-Laws, three technical papers reporting the results of cooperative research were presented.

Prof. F. B. Rowley, of the University of Minnesota, was introduced and described the Insulating Value of Bright Metallic Surfaces. (Published in *Heating, Piping and Air Conditioning,* June, 1934). This paper, which is of timely interest, discussed test results of the effect of bright metallic surfaces on heat transmission coefficients and showed reasonable average coefficients which may be used in practice. Written discussions were submitted by J. H. Bracken, P. D. Close, and Prof. E. R. Queer and additional comments were offered by R. P. Cook, Prof. M. K. Fahnestock, L. A. Harding, R. T. Miller, and E. B. Svenson to which Professor Rowley replied.

With Vice-Pres. John Howatt, chairman of the Committee on Research, in the chair, the next paper, entitled Heat Transfer from Direct and Extended Surfaces with Forced Air Circulation, by Prof. G. L. Tuve and C. A. McKeeman, was presented by Professor McKeeman. (Published in *Heating, Piping and Air Conditioning,* June, 1934). This preliminary report on cooperative research work at Case School of Applied Science was of particular interest and discussions were given by Professor Fahnestock and Professor Rowley and their queries were answered by Professor Tuve.

President Haynes resumed the chair and asked Professor Fahnestock, University of Illinois, to present the final paper of the meeting, Factors Affecting the Heat Output of Convectors, by Prof. A. P. Kratz, M. K. Fahnestock and E. L. Broderick. (Published in *Heating, Piping and Air Conditioning,* July, 1934). Professor Rowley had several comments to make on this paper, to which Professor Fahnestock replied.

Resolutions

Action was taken on the adoption of the following resolutions, which were presented by R. H. Carpenter, chairman of the Resolutions Committee:

RESOLVED, that this Semi-Annual Meeting extend to the Philadelphia Chapter and its Committee of Arrangements who planned the enjoyable entertainment and other recreational features, its appreciation and thanks for the extremely pleasant time enjoyed by all.

RESOLVED, that the A.S.H.V.E. assembled at the Semi-

Annual Meeting 1934, extend to the management and the staff of The Inn its hearty thanks and appreciation for the splendid accommodations and courteous services rendered to its members and guests.

RESOLVED, that the A.S.H.V.E. members attending the 1934 Semi-Annual Meeting express to the Program Committee and the speakers and authors of papers, their satisfaction and pleasure for the interesting and instructive data presented during the technical sessions.

RESOLVED, that the A.S.H.V.E. express its cordial thanks to the *A.S.R.E.* for its friendly cooperation and participation in the joint sessions and social events of the two organizations.

RESOLVED, that the 1934 Semi-Annual Meeting of the A.S.H.V.E. express its appreciation and thanks to the trade and daily press for their attendance and the generous publicity given to our meeting.

RESOLVED, that the members have observed with much pleasure the attendance of 10 of our past presidents and desire to express our hearty thanks for the continued interest of these "old timers."

And be it further *RESOLVED,* that President Haynes receive the universal commendation of those in attendance, especially the ladies, for his fatherly interest in their welfare and enjoyment.

On motion of W. T. Jones, seconded by Albert Buenger, the resolutions were unanimously adopted, and the meeting adjourned.

The Council Meeting

On Tuesday evening, June 19, with 13 of the 17 members of the Council in attendance, a four-hour session was held and the recommendations of the Committee on the Constitution and By-Laws were discussed and approval was given to the new Constitution and By-Laws submitted by the Massachusetts Chapter.

Prof. F. E. Giesecke of the Agricultural and Mechanical College of Texas was appointed to represent the Society on the *National Research Council* for a three-year term commencing July 1, 1934.

In accordance with the By-Laws the Council nominated five members to serve on the Committee on Research for a three-year term commencing in 1935.

After a lengthy discussion of meeting invitations from several chapters, individuals and cities, it was finally decided to accept the offer of the Western New York Chapter to act as hosts for the 41st Annual Meeting, which is to be held during the fourth week in January at Buffalo.

Routine action in accordance with the provisions of the By-Laws was taken on the reinstatement of four men, the acceptance of 11 resignations and on the requests for cancellation of membership made by several members.

Those present at the Council Meeting were C. V. Haynes, Philadelphia; M. C. Beman, Buffalo; D. S. Boyden, Boston; Albert Buenger, St. Paul; R. H. Carpenter, New York; J. D. Cassell, Philadelphia; F. E. Giesecke, College Sta., Texas; E. H. Gurney, Toronto; John Howatt, Chicago; W. T. Jones, Boston; G. L. Larson, Madison, Wis.; J. F. McIntire, Detroit; F. C. McIntosh, Pittsburgh; A. V. Hutchinson, Secy., and by invitation, C. F. Roth, New York.

Committee on Research

A meeting of the Committee on Research was held at The Inn, Buck Hill Falls, Pa., on Tuesday afternoon, June 19, with a majority of the members present when Chairman John Howatt called the meeting to order. Those present were: C. A. Booth, Albert Buenger, F. E. Giesecke, F. C. Houghten, A. P. Kratz, G. L. Larson, A. J. Nesbitt, J. H. Walker, A. C. Willard, N. D. Adams, C. V. Haynes, H. F. Hutzel, H. C. Murphy, and K. R. Knapp.

Important subjects for discussion were the renewal of the agreement with the U. S. Bureau of Mines, the report of the Research Finance Committee, and a discussion of the work of Technical Advisory Committees

Guide Publication Committee Meets

During the Semi-Annual Meeting of the Society at Buck Hill Falls, Chairman Walter Fleisher held a meeting of the Guide Publication Committee, which was attended by John Howatt, Professor Larson, Professor Sawdon, Professor Giesecke, J. H. Walker, F. C. Houghten, Pres. C. V. Haynes and Secy. A. V. Hutchinson.

Various chapter assignments were discussed and those in charge reported on the status of the work.

The setup for THE GUIDE 1935 was approved and a number of new ideas are to be introduced in this 13th edition of the Society's reference data book so that it will be more useful.

Italian Member Returns to Milan

When the *S.S. Rex* of the Italian Line sailed from New York on Saturday, July 21, it carried Mr. and Mrs. Aldo Gini of Milan, Italy, who are homeward bound after spending six weeks in the United States.

Mr. Gini, a member of the A.S.H.V.E., was particularly interested in studying American combustion methods, central steam and hot water heating systems and modern practice in air conditioning. During his stay, he visited the A.S.H.V.E. Research Laboratory at the U. S. Bureau of Mines, Pittsburgh, and attended the convention of the *National District Heating Association* in Rochester. His itinerary included Buffalo, Niagara Falls, Cleveland, Chicago, for a visit to the Century of Progress, Pittsburgh and Washington, D. C.

Mr. and Mrs. Aldo Gini

Before their departure Mr. and Mrs. Gini expressed their regret that their arrangements could not include attendance at the Society's Semi-Annual Meeting in June, but they have most pleasant recollections of the courteous reception that they received from many of the Society members, whom they met during their visit.

A·S·H·V·E· MEMBERS FIND

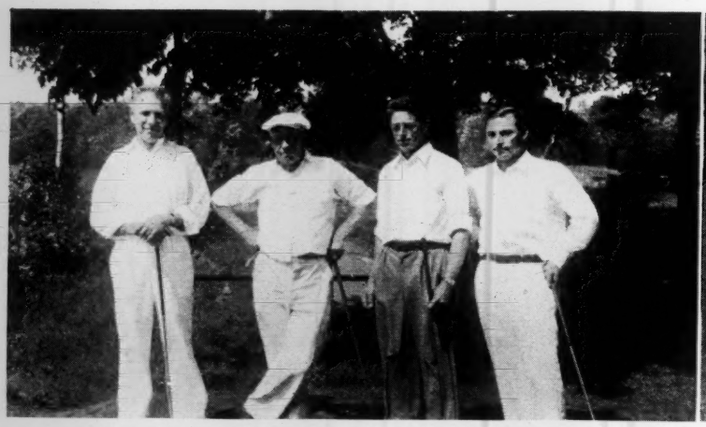
A Path Through the Laurel

Lower Buck Hill Falls

Pres. C. V. Haynes and I. C. Jennings with Past Presidents L. A. Harding and W. H. Carrier

PLEASURE *in the* POCONOS

Nice for a Morning Dip



Left to Right—John Howatt, 1st Vice-President; D. S. Boyden, Treasurer; W. L. Fleisher, Chairman, Guide Publication Committee; Warren Webster, Jr.

W. H. Driscoll, Past-President; R. H. Carpenter, Council Member; R. C. Bolsinger, General Chairman, Committee on Arrangements

Fun at Buck Hill Falls

THE Poconos were dressed in their finest foliage for the Semi-Annual Meeting of the Society June 19 to 22 with a profusion of laurel and rhododendron blossoms covering the hillsides and perfuming the cool bracing air.

The Inn at Buck Hill Falls was a happy selection and the surrounding country offered fine roads for motoring, interesting trails for hiking and riding, and splendid facilities for recreation of all kinds were right at the doorstep. The golfers had 27 holes on which to try their skill; tennis courts were of championship quality and for those who wished less violent forms of exercise swimming, bowling on the green, shuffleboard and croquet were available. Everyone of the 300 members, guests and ladies who attended found enjoyment in one or more of the recreational programs which were conducted under the direction of the Philadelphia Chapter's Committee on Arrangements. There were three golf tournaments for men and one for the ladies. The special program for the ladies included a bridge luncheon at the Tennis Club, an auto ride thru the Poconos and a duplicate bridge and tea during the three days stay. Both the men and ladies enjoyed the beefsteak dinner held jointly with the *A. S. R. E.* on Skytop Mountain and the Semi-Annual banquet, entertainment and dance held at The Inn.

Many members made the Semi-Annual Meeting a part of their vacation and among the early arrivals were Pres. C. V. Haynes and his family, Ardmore, Pa., A. C. Willard, newly elected president of the University of Illinois and Mrs. Willard, Urbana, Ill., Vice-Pres. John Howatt and Chairman of the Committee on Research, Mr. and Mrs. J. I. Lyle, Plainfield, N. J., and Mr. and Mrs. H. C. Murphy, Louisville, Ky. Some of the motorists who came early were Mr. and Mrs. J. F. McIntire, Detroit, E. H. Gurney and his family, Toronto, Mr. and Mrs. G. E. Otis, Moline, and Prof. G. L. Larson, Madison, Wis. The members who held the long distance travelling record are Prof. F. E. Giesecke, College Station, Texas, Prof. F. B. Rowley, Minneapolis, and Albert Buenger, St. Paul.

Of the 17 members of the Council 13 were present for the dinner and meeting held Tuesday night and while this prolonged business session was in progress, the other members and guests enjoyed the concert of a talented group of musicians, the Ernest Gamble Trio.

At noon on Wednesday a Get-Together luncheon was held in the main dinning room of The Inn and Colonel Willard T. Chevalier, Vice-President of McGraw Hill Publishing Co., gave a splendid address entitled Examining the Construction Recovery Program. At the conclusion of the luncheon the golfers went to the Buck Hill Falls course and played an 18-hole tournament under the direction of W. P. Culbert, chairman of the Golf Committee. Of the 46 members participating Walter Voisinet had the best card, winning the honors in both low gross and low net.

The Research Tournament was held on Thursday at Buck Hill course and 44 members played. When the final count had been made in this 18-hole medal play handicap tournament, it was found that J. F. McIntire had played a sensational round and was entitled to the Research Cup for the coming year. In the 18-hole round he holed his approaches on 3 occasions and had 5 one-putt greens. The scores:

Name	*Gross*	*Handicap*	*Net*
Fiedler, H. W.	141	28	113
Murphy, J. R.	128	28	100
Driscoll, W. H.	105	28	77
Fenton, F. A.	105	22	83
Everetts, J. J. Jr.	134	30	104
Harvey, A. D.	113	25	88
Fleisher, W. L.	99	21	78
Boyden, D. S.	102	22	80
Webster, W. Jr.	92	20	72
Howatt, John	105	20	85
Moore, R. E.	89	15	74
Hedges, H. B.	102	25	77
Eichberg, W. R.	95	22	73
Gaylord, F. R.	108	24	84
Culbert, Wm. P.	84	11	73
Fenner, N. P.	95	12	83
Souie, L. C.	115	30	85
Chester, T.	113	30	83
Tuttle, J. F.	101	18	83
Adams, N. D.	110	21	89
Otis, G. E.	91	15	76
Arnold, R.	125	28	97
Erickson, H. H.	133	30	103
Luck, A. W.	136	30	106
Kriebel, A. E.	141	30	111
Black, H. G.	153	30	123
Osborn, W. J.	94	14	80
Keeney, Frank P.	119	26	93
Boales, Wm. G.	121	30	91
Randall, W. C.	107	30	77
Winans, G. D.	111	30	81
Miller, R. J.	102	25	77
Lloyd, E. C.	116	24	92
Hutzel, H. F.	101	30	71
Novotney, T. A.	116	30	86
Voisinet, W. E.	84	9	73
Beman, M. C.	113	30	83
McIntire, J. F.	87	23	64
Gurney, E. H.	111	20	91
Simpson, D. C.	103	20	83
Carrier, W. H.	107	22	85
Harding, L. A.	116	30	86
Haynes, C. V.	98	22	76
Jennings, I. C.	114	26	88
Olsen, G. E.	102	21	81

The Kicker's Handicap for ladies was held on Thursday and those who played were Mrs. G. E. Otis, Mrs. H. C. Murphy, Miss Mary J. Driscoll, Mrs. L. C. Soule and Mrs. W. E. Heibel with Mrs. Otis and Mrs. Murphy taking the honors.

On Friday the Golf Committee gave members and guests change of scenery. A Kicker's Handicap Tournament was played at Skytop course, with 30 players hitting the trail at 2:00 p. m. The winning golfer was H. H. Erickson, Philadelphia. In this tournament J. F. McIntire used the new set of golf clubs which he had received on the previous day as a reward for his sensational play and they brought him home in second place. He found the hilly Pocono golf courses made to order and returned to Detroit with the Research Cup, a set of wood clubs and an electric waffle iron. W. C. Randall carried off a handsome sport bag and H. J. Carr, W. R. Eichberg and L. C. Soule received golf balls.

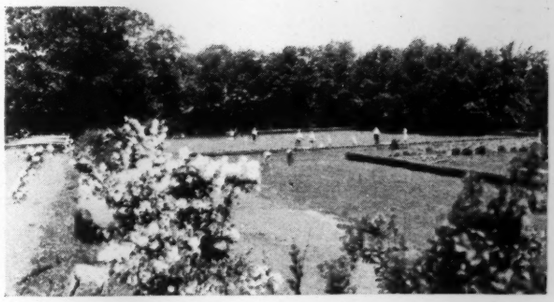
The old rivalry between President Haynes and Past President W. H. Carrier was renewed and C. V. carried off the honors. R. C. Bolsinger, general chairman of the Committee on Arrangements returned to the golfing wars after a long lay off and it was nice to see Ray turn in a net 88. Col. Dave Boyden was consistent in his shot making and did his best scoring at Buck Hill. Frank Gaylord in a pre-tournament statement expressed his desire for a burro but the rule makers would not approve of introducing the polo technique in the ancient Scotch pastime.

J. F. McIntire, Winner of the Research Cup

Dinner on the mountain at 7:00 p. m. on Wednesday evening was a fitting climax to an enjoyable day. Early in the afternoon, the steward of Skytop Lodge had brought truckloads of food to the summit of Skytop Mountain and a few minutes after the members of the *A. S. R. E.* and A. S. H. V. E. arrived, supper was served buffet style. In short order 300 steaks, bowls of relishes, bushels of vegetables, numerous cakes, many iced watermelons and gallons of coffee disappeared. There was beer on tap for those who preferred it. Seated in small groups the Society members had an unobstructed view across the mountains and valleys for nearly 50 miles with Mt. Pocono and Delaware Water Gap clearly outlined.

The weather was clear and a gorgeous sunset rewarded those who stayed on the mountain top until dusk. A large group returned to Skytop Lodge and The Inn where the merriment was continued.

At noon on Thursday M. C. Gillett and his Committee conducted the ladies to Buck Hill Tennis Club for a bridge luncheon. There were eight tables of contract bridge and those who scored best were Mrs. T. F. Blackwell, Mrs. W. E. Heibel, Mrs. L. C. Soule, Mrs. C. V. Haynes, Mrs. G. D. Winans, Mrs. H. S. Wheller, Mrs. N. D. Adams and Mrs. A. Klemmer.



Lawn Bowling and Croquet

In the afternoon on Friday a duplicate bridge tournament was played at The Inn and Mrs. L. C. Soule received a set of Duplicate Boards.

The Semi-Annual Dinner Dance was held in the main dining room of The Inn, Thursday evening, and between courses the Adelphia Orchestra provided music for dancing and gave several specialty numbers featuring several of the instrumentalists. The Adelphia Quartette made a great hit with their novelty numbers and were recalled time after time.

At the conclusion of the dinner M. F. Blankin introduced the past presidents of the Society, 10 of whom were in attendance at the meeting namely—Homer Addams, W. H. Carrier, W. H. Driscoll, H. P. Gant, L. A. Harding, J. D. Hoffman, W. T. Jones, J. I. Lyle, F. B. Rowley and A. C. Willard.

L. A. Harding, President of the Society in 1930, presented a handsome leather bound memory book to W. T. Jones, Boston, who served the Society as President in 1933 and Mr. Jones made a brief response in appreciation.

First Vice-President John Howatt, Chairman of Committee on Research was introduced by the Toastmaster and in a brief speech presented the Research Cup to J. F. McIntire, Detroit.

W. P. Culbert, President of the Philadelphia Chapter and Chairman of the Golf Committee, was called upon to present the golf prizes and the following awards were made: W. Voisinet, Buffalo, traveling case; R. N. Trane, La Crosse, sport bag; H. B. Hedges, New York, electric clock; Warren Webster Jr., Camden, N. J., electric toaster; D. S. Boyden, Boston, golf balls; Wallace Osborn, New York, golf balls; J. F. McIntire, Detroit, three wood clubs; R. E. Moore, Chicago, sparklet syphon; H. F. Hutzel, Waterbury, Conn., golf bag; W. R. Eichberg, Philadelphia, thermos set; C. V. Haynes, Philadelphia, golf balls; G. E. Otis, Moline, golf balls: Mrs. G. E. Otis, sandwich platter and Mrs. H. C. Murphy, perfume bottle.

The Toastmaster called upon President Haynes to speak and

W. T. Jones, Past President, Says Good-Bye to E. H. Gurney

Mr. Haynes expressed his pleasure for the fine attendance of members and guests.

With a few gracious words of introduction the Toastmaster told of the honors that had been conferred upon a fellow member and past president of the Society and expressed the pleasure of the members in knowing of the recent selection of Dean A. C. Willard as President of the University of Illinois. The privilege of having him as the speaker of the evening was a great honor and Dean Willard was greeted with enthusiasm by his fellow members. He spoke briefly on improving the status of the engineer as a professional man.

At the conclusion of the formal program the floor was cleared for dancing and the orchestra and quartette entertained until 1:00 a. m.

On Friday morning the ladies assembled for a motor trip to various points of interest in the Poconos and in a two hour motor trip they saw some of the outstanding places of historic interest, as well as the natural beauties of the mountains.

For luncheon on Friday a special menu had been arranged for members and guests and the featured dish was Pocono Mountain trout, a native of the surrounding streams that provides great sport for fishermen and a delightful dish at any time.

Everyone had a good time and all said that they were glad they accepted the Philadelphia Chapter's invitation to come to the Poconos. The committees responsible for handling the preliminary arrangements and social features were:

Semi-Annual Meeting Committees

Committee on Arrangements: R. C. Bolsinger, General Chairman. *Banquet Committee:* M. F. Blankin, *chairman;* J. D. Cassell and A. E. Kriebel. *Finance Committee:* W. F. Smith. *Transportation and Publicity Committee:* J. H. Hucker, *chairman;* A. E. Dambly, H. H. Erickson, H. P. Gant and R. E. Jones. *Entertainment Committee:* W. R. Eichberg, *chairman. Registration and Reception Committee:* H. G. Black, *chairman;* Benjamin Adams, G. W. Barr, R. S. Arnold, J. D. Cassell, H. P. Gant, R. E. Jones, F. D. Mensing and A. J. Nesbitt. *Golf Committee:* W. P. Culbert, *chairman;* M. F. Blankin and Mrs. W. R. Eichberg. *Ladies Committee:* M. C. Gillett, *chairman;* Mrs. M. F. Blankin, Mrs. W. P. Culbert, Mrs. W. R. Eichberg, Mrs. H. H. Erickson, Mrs. J. H. Hucker and Mrs. A. E. Kriebel.

Cleveland

April 30, 1934. The April meeting of the Cleveland Chapter was held at the laboratory of the *American Gas Association.* Pres. F. A. Kitchen called the members to order at 8:15 p.m.

In the absence of the treasurer, President Kitchen reported the action of the Board of Governors in extending the period for discounting dues.

Philip Cohen reported one new application for membership in the Society.

The principal business of the evening was the election of a Nominating Committee to submit at the next meeting a list of candidates for the various offices. R. G. Davis nominated C. F. Eveleth to act as chairman of the committee. Mr. Eveleth, however, declined and nominated W. E. Stark and R. G. Davis. J. S. O'Gorman nominated T. A. Weager. As there were no further nominations the members listed were unanimously elected.

President Kitchen made a brief announcement regarding the Semi-Annual Meeting of the Society and then introduced R. M. Conner who discussed the organization of the *A. G. A.* and explained the function of the laboratory, telling why it is located in Cleveland and why a similar laboratory is maintained at Los Angeles. A discussion of the growth of the gas industry lead to the statement that gas rates in the future would be lower and gas would be used more extensively for house heating and air conditioning.

Following Mr. Conner's talk the members and guests were conducted on an inspection tour of the building. Members of the staff explained how the various tests are made to determine if appliances meet the approval requirements and demonstrated how fundamental research on flue gas temperature is conducted.

Illinois

May 25, 1934. A special social meeting of the Illinois Chapter was attended by 35 members, who enjoyed a delightful dinner at the Germania Club, when Pres. C. W. DeLand acted as impromptu toastmaster. The good food and excellent musical entertainment made the early evening most enjoyable.

At 8:00 p. m. the meeting adjourned to the new building recently erected by the Chicago Historical Society in Lincoln Park and the A. S. H. V. E. group enjoyed a special showing of the many interesting exhibits concerning the early history of Chicago.

Everyone present voted the party a great success and a fitting conclusion to the chapter season of 1933-34, according to the report of the secretary, J. J. Hayes.

May 14, 1934. Fifty-one members and guests met for the regular monthly meeting of the Illinois Chapter at the Hotel Sherman. Pres. C. W. DeLand called the gathering to order and the minutes of the April meeting were read and approved.

A communication from the Philadelphia Chapter outlined the probable expense of a trip from Chicago to the Summer Meeting at Buck Hill Falls, Pa., and every member was urged to attend.

President DeLand then welcomed a new member, E. B. White, and called attention to a special meeting scheduled for May 25.

The speaker of the evening was Dr. James Aston, consulting metallurgist, who discussed the subject of Corrosion in Heating and Ventilating and Air Conditioning Apparatus.

Dr. Aston approached this complex problem from the electrochemical point of view, using the action of an ordinary primary cell as an illustration. He emphasized the point that a potential difference alone between dissimilar metals will not produce corrosion, but that a flow of current must be present through a conductive medium.

The speaker described the ionization of water, the usual electrolyte, and the collection of hydrogen on the negative pole of the cell, commonly called polarization. He spoke of the use of various materials to prevent corrosion, such as wrought iron, cast iron, copper bearing steel and other alloys, as well as protective coatings such as tin, zinc, and paints.

A brief discussion of various methods of water treatment by the use of deaerators, deactivators and ordinary open heaters followed and the retention in the water of a slight lime film or scale forming material was advocated.

Dr. Aston closed his talk by stating that the metallurgist is doing all in his power to develop better material and that competitive rivalry between manufacturers has produced great strides in the art of corrosion prevention.

A motion picture followed, which illustrated in detail the manufacture of wrought iron at the plant of the A. M. Byers Co.

A general discussion of this interesting talk closed the meeting at 10:20 p. m.

Michigan

May 16, 1934. After an afternoon of golf and baseball at the Meadowbrook Golf Club, about 60 members met for the annual meeting and election of officers of the Michigan Chapter.

Pres. H. E. Paetz asked for roll call and the minutes of the last meeting and R. K. Milward, treasurer, reported $176.00 in the treasury.

The report of the Nominating Committee was read and it was regularly moved and seconded that the nominations be closed. Upon motion of R. L. Spitzley, seconded by A. G. Pittelkow, it was voted that the acting secretary be instructed to cast a

unanimous ballot for the officers as presented by the Nominating Committee. Election by ballot for members of the Board of Governors took place and following are the officers elected:

President—G. D. Winans.
Vice-President—A. C. Wallich.
Treasurer—R. K. Milward.
Secretary—W. F. Arnoldy.
Board of Governors: H. E. Paetz, Edward Glanz, J. S. Kilner, and F. J. Feely.

The Golf Committee then distributed the golf awards: For low gross Eddie Anderson, H. E. Paetz, and A. A. Emrick; kickers' handicap, G. H. Cummins, Tom Brown, R. F. Connell, F. J. Feely, H. E. Paetz, W. Hampton and F. Marzolf. The attendance award was made to W. H. Olds.

Motions for votes of appreciation for the retiring president, H. E. Paetz, and for the work done by the Program Committee, were offered by Messrs. Kilner and Milward respectively.

After the appointment of H. A. Hamlin and E. H. Clark as auditors, G. D. Winans reports that the meeting adjourned.

April 16, 1934. Approximately 150 members and guests met at the Hotel Wardell for the April meeting of the Michigan Chapter. After dinner Pres. H. E. Paetz asked for roll call and reports of the Secretary, Treasurer and Membership Committee.

President Paetz then introduced C. L. Toonder, who discussed the development and application of a humidity chart.

The second speaker was E. E. McWan, who stressed the importance of well trained salesmen in the air conditioning field. He also gave some interesting statistics relating to air conditioning.

E. L. Hogan gave an interesting discussion of some of the technical points of the industry.

Following these talks, Messrs. Clark, Rowe, Chester, King Hadjisky, Harrigan, and Cockrell engaged in discussion before the meeting was adjourned.

Minnesota

April 10, 1934. Forty-six members and guests of the Minnesota Chapter met at the Men's Union, with Pres. A. B. Algren presiding. The chairman of the Program Committee, D. M. Forfar, reported that the May meeting would in general be similar to that of other years, consisting of an afternoon of golf, followed by dinner, the election of officers and a social hour.

W. F. Uhl, chairman of the Nominating Committee, reported the following candidates for office:

President—C. E. Lewis
Vice-President—C. E. Gausman
Secretary-Treasurer—R. E. Backstrom
Directors—A. B. Algren and F. C. Winterer

President Algren told of the recommendation of the Executive Committee that an amount not to exceed $100.00 be allowed their Council member for traveling expenses. The motion, made by M. H. Bjerken, that the Chapter authorize this expenditure was seconded and passed.

Albert Buenger moved that the duties of the Nominating Committee include the classification of new members to be forwarded with the applications to headquarters' office. This motion was seconded and passed.

A review of the Code of Fair Competition for the Professional Engineers Division of the Construction Industry was given by Mr. Buenger, who requested that the Chapter give its approval of the code as finally written if it saw fit. H. E. Gerrish moved that the Chapter approve the code and this motion was seconded and passed.

Prof. F. B. Rowley gave a very interesting talk on the insulating value of bright shiny surfaces, such as aluminum tin foil, aluminum paint, etc. Secretary Gausman reports that after a very instructive discussion, the meeting adjourned.

Ontario

May 15, 1934. The annual meeting of the Ontario Chapter was held at the Engineers Club with 37 members present.

Following dinner reports were received from the Attendance Committee and the Membership Committee and it was noted that during the past year the Ontario Chapter had obtained 14 new members.

The report of the auditors as to the standing of the treasury was accepted as read.

Secy. H. R. Roth outlined the history of the award which the Ontario Chapter gives annually to the student at the University of Toronto for the best thesis on heating and ventilation or air conditioning.

Election of officers was held with the following results:

President—W. R. Blackhall.
Vice-President—M. W. Shears.
Secretary-Treasurer—H. R. Roth.
Board of Governors—J. S. Paterson, Thomas McDonald, G. A. Playfair and W. P. Boddington (non-elective).

The retiring president, Mr. Boddington, introduced the guests of honor, C. V. Haynes, Philadelphia, Pa., president of the A. S. H. V. E., and John Howatt, Chicago, Ill., 1st vice-president of the Society and chairman of the Committee on Research.

Mr. Howatt delivered a very instructive and interesting address on the activities of the Research Laboratory at Pittsburgh, Pa.

Following Mr. Howatt's address, President Boddington asked E. H. Gurney, member of the Council, to introduce President Haynes, who spoke on the benefits derived from membership in the Society.

At the close of the meeting the new officers were installed and the meeting adjourned for a social evening at the Engineers Club.

Philadelphia

May 10, 1934. The regular meeting of the Philadelphia Chapter was held at the Roxboro Country Club and was called to order by Pres. W. P. Culbert. L. P. Hynes, chairman of the committee to secure members for the Engineers Club, made a short address outlining the benefits of membership and asked for the support of those present.

J. H. Hucker spoke of the Society's Semi-Annual Meeting in June at Buck Hill Falls, Pa., and announced an award to P. L. Pryibil for the wording of a poster used in connection with publicity for the meeting. A memento was also given to C. A. Mosquera for the lettering on the poster.

A Kicker's Handicap Tournament produced the unusual result of four 76's so that four awards were made by W. F. Smith, chairman of the Meetings Committee.

Secy. W. R. Eichberg reports that the meeting adjourned as early as possible to permit members and guests to enjoy other entertainment features that had been provided to top off a most successful season.

April 12, 1934. The meeting of the Philadelphia Chapter, held at the Engineers Club, was opened by Pres. W. P. Culbert with a few moments of silent prayer for Dean F. Paul Anderson, Past President of the Society, who had recently passed away.

The minutes of the March meeting and the treasurer's report were read and approved.

Ira Thomas, scout for the Philadelphia American League baseball club, gave a most interesting talk on baseball plays and players. He closed with the plea that the members attend the Boy Scout Pageant at Convention Hall, April 19-21.

President Culbert requested Secy. W. R. Eichberg to read a letter of congratulations he had written to Prof. A. C. Willard, recently elected president of the University of Illinois, and Professor Willard's reply.

Nominations for members of the Chapter Nominating Committee were called for and Morris Sheffler presented the following names: M. F. Blankin, chairman, A. H. MacDade, L. P. Hynes,

F. D. Mensing and A. A. Miller. On motion made and seconded, the nominations were closed and the secretary was instructed to cast a ballot for their unanimous election.

Alexander McClintock, Jr., chairman of the Membership Committee, reported three new members: J. G. Stalb, Chester Kaczenski and C. J. Hansen.

C. V. Haynes, president of the A.S.H.V.E. and a member of the Philadelphia Chapter, gave an interesting short talk on conditions within the Society and asked for the cooperation of the Chapter in supporting Society activities.

J. H. Hucker spoke of the Semi-Annual Meeting to be held at The Inn, Buck Hill Falls, Pa., in June, when the Philadelphia Chapter will be host to the Society.

An address on The Swing to Purchased Steam in Philadelphia was given by V. P. Alley, of the Philadelphia Electric Co., and numerous questions on this subject were answered during the discussion.

The meeting which was attended by 53 members and guests adjourned soon after 10:00 p.m.

Pittsburgh

April 30, 1934. Pres. P. A. Edwards called the regular monthly meeting of the Pittsburgh Chapter to order in the auditorium of the U. S. Bureau of Mines. Following the reading and approval of the minutes of the April 9 meeting, H. A. Beighel gave the monthly treasurer's report, which was accepted and ordered filed. Mr. Beighel then spoke of the necessity of all members paying their dues promptly.

T. F. Rockwell, chairman of the Membership Committee, stated that since his last report there had been one associate member and two student members admitted to the A.S.H.V.E. from the Pittsburgh district, that there had been two changes in grade of membership, and that there were two applicants for membership.

It was moved by E. C. Evans, seconded by T. M. Dugan, and carried that a committee be appointed to draft a resolution of regret on the death of Dean F. Paul Anderson to be spread upon the records of the chapter and to be forwarded to his widow. President Edwards appointed the following members: E. C. Evans, chairman; H. L. Moore and F. C. Houghten.

President Edwards reported for a committee which had considered the desirability of the Pittsburgh Chapter joining a movement to bond local relations among the several local chapters of national engineering societies. After a considerable discussion, it was moved by Mr. Houghten, seconded by F. A. Gunther, and carried, that the Board of Governors of the Pittsburgh Chapter be instructed to investigate the desirability of such combination and to take whatever action in behalf of the Pittsburgh Chapter they deemed desirable.

Following a discussion of the most recent draft of the Code for the Engineering Division of the Construction Industry, it was moved, seconded, and carried that the Board of Governors study the details of the Code and convey the feeling of the Chapter to the proper authorities.

F. C. McIntosh was then presented by President Edwards and spoke briefly on Membership in the A.S.H.V.E. By giving Society history, presenting many data concerning the present organization of the Society, and enumerating benefits derived, he convincingly showed why men of character connected with heating, ventilating or air conditioning should become members.

The next speaker was F. C. Houghten, director of the A.S.H.V.E. Research Laboratory, who addressed the group on Research. Mr. Houghten told of the work now being done at the Society's laboratory and at co-operating universities. By drawing parallels between work done at the Pittsburgh laboratory and changes made in The Guide text section since its first edition in 1922, he was able to demonstrate how closely the laboratory has been connected with the improvement and amplification of many types of engineering data.

C. V. Haynes, president of the A.S.H.V.E.. was the Chapter's guest and speaker and was introduced by President Edwards. Mr. Haynes spoke on Your Society—What Does It Mean to You?, and in his spirited and inspiring address he gave a complete picture of the business and technical organization of the Society and included a summary of its financial setup. The many advantages gained through membership in an ethical society because of its activities, publications, research, meetings, and contacts were pointed out. He also told of plans for THE 1935 GUIDE.

President Haynes answered many questions concerning the Society and at his suggestion a motion was made and carried that President Edwards appoint a local committee to carefully review THE 1934 GUIDE and assist the GUIDE Publication Committee in planning for the next edition. C. M. Humphreys was appointed as chairman, with Messrs. Rockwell, Evans and Edwards as members of the committee.

At the close of the discussion Mr. Haynes was tendered a rising vote of thanks before the meeting adjourned.

April 9, 1934. There were 50 members and guests present in the auditorium of the U. S. Bureau of Mines, when Pres. P. A. Edwards called the meeting to order. The minutes of the previous meeting and the report of the treasurer, H. A. Beighel, were read and accepted. R. B. Stanger, chairman of the Program-Publicity Committee, stated that arrangements were being completed to have C. V. Haynes, president of the A.S.H.V.E., and John Howatt, first vice-president and chairman of the Committee on Research, as the Chapter's guests and speakers at the May meeting.

President Edwards called upon the members to pay their current and delinquent dues.

A letter from the Philadelphia Chapter was read, inviting Pittsburgh members to attend the Semi-Annual Meeting in the Pocono Mountains and all were urged to go.

The most recent draft of the Code for the Engineering Division of the Construction Industry was next brought before the meeting and its accompanying letter of transmittal from the headquarters office of the Society was read. After discussion, a committee consisting of E. C. Evans, F. C. McIntosh and H. L. Moore was appointed to study the code and report on it at the May meeting.

A letter, which was read from a local group of engineers representing the *A.S.M.E.*, the *A.I.A.*, the *A.I.E.E.*, the *A.S.C.E.* and others, including the *Engineers Society of Western Pennsylvania*, invited the Pittsburgh Chapter of the A.S.H.V.E. to send representatives to a luncheon conference for the purpose of strengthening and bonding the relations among the engineering groups through joint meetings. After members had expressed their opinions that this was a worthwhile and excellent idea, E. C. Evans, F. C. McIntosh, R. B. Stanger and P. A. Edwards were appointed to attend this preliminary luncheon and report to the Chapter at the May meeting concerning further plans.

C. M. Humphreys presented the Chapter's guest and speaker, C. A. Reed, combustion engineer, who first spoke on the importance of correct coal preparation with related methods of combustion, and then presented a motion picture showing actual mining operations by the most modern methods, and the subsequent cleaning and preparation given to coal at the surface before shipment. In his excellent talk, Mr. Reed showed why the subject of coal utilization in the Pittsburgh district is of utmost importance to local heating and ventilating engineers.

After a full and complete discussion covering all phases of coal mining, coal cleaning, sizing and coal combustion, Mr. Reed was given a rising vote of thanks in appreciation of his talk. The meeting was adjourned at 10:00 p.m., according to the report of Secy. J. L. Blackshaw.

St. Louis

May 9, 1934. About 25 members and guests of the St. Louis Chapter attended the meeting held at Joe Garavelli's, De Baliviere and De Giverville when C. V. Haynes, president, and John Howatt, vice-president of the A. S. H. V. E., were present. The

minutes of the April meeting were read and approved and the treasurer reported a balance on hand of $439.18.

J. W. Cooper spoke on the advisability of having a summer party and it was moved by E. E. Carlson, seconded and carried, that the matter be left to the Entertainment Committee.

The chairman of the Membership Committee, D. J. Fagin, reported the reinstatement of T. W. McMahon and the election of Frank Fillo.

The subject of holding the A. S. H. V. E. 1935 Annual Meeting in St. Louis was thoroughly discussed and the visiting national officers of the Society were impressed with the desirability of this action.

John Howatt, 1st vice-president and chairman of the Committee on Research, was introduced by L. W. Moon, member of the Council. Mr. Howatt spoke on the research activities of the Society and outlined the various programs now under way and those which are contemplated.

C. V. Haynes, president of the A. S. H. V. E., was then presented by Mr. Moon and gave a very interesting talk on Your Society, What Does It to Mean You? President Haynes explained in detail the condition and affairs of the Society and, following his talk, many suggestions were made from the floor regarding THE A. S. H. V. E. GUIDE.

An entertaining talk, which might well have been called, The Experiences of a Manager, was given by F. H. Gaylord of Chicago.

A rising vote of thanks was tendered the speakers, after which the meeting adjourned.

Pacific Northwest

May 8, 1934. The May meeting of the Pacific Northwest Chapter was held at the Hungerford Hotel on Tuesday evening with 20 members and guests present. Pres. P. M. O'Connell announced that a unanimous ballot had been cast for the following officers for 1934-35:

President—A. L. Pollard.
Vice-President—Lincoln Bouillon.
Secretary—S. D. Peterson.
Treasurer—W. W. Cox.

The newly elected officers were introduced and installed in office and a rising vote of appreciation was given Mr. O'Connell, former president for his untiring efforts in behalf of the Chapter.

The evening's speaker was F. J. Pratt, of the machinery drafting department of the U. S. Navy Yard at Bremerton. Mr. Pratt gave an interesting and instructive talk on ventilation aboard modern battleships. He described some of the problems of ventilation not encountered in ordinary practice among which are the precautions taken to isolate various sections of the ships in time of action and the necessity for defense against gas attack.

The Semi-Annual Meeting of the A. S. H. V. E. at Buck Hill Falls, Pa., was discussed and it was unanimously agreed that in the matter of publicity the Philadelphia Chapter were to be congratulated on the efforts they have made in acquainting other Chapters with the desirability of attending.

A decision to hold a summer Chapter meeting which would consist of a trip to the Skagit, municipally owned power development site, was followed by adjournment.

Western New York

May 14, 1934. The Western New York Chapter members met at the Touraine Hotel with an attendance of 35 for dinner and 40 at the meeting which followed.

F. G. Zander in his inimitable manner gave a few of his poetic selections for the entertainment of the group.

The chapter was honored by the presence of two national officers, who were introduced by L. A. Harding, acting chairman.

C. V. Haynes, Philadelphia, Pa., president of the A. S. H. V. E., was introduced and outlined in detail the activities of the Society since the last Annual Meeting, giving some very encouraging information on the maintenance of membership. President Haynes also spoke of the plans for the Summer Meeting at Buck Hill Falls, Pa., and urged everyone to attend.

John Howatt, Chicago, Ill., 1st vice-president of the Society and chairman of the Committee on Research, discussed the work being done under the direction of the Committee on Research and his talk on the advancement in this branch of Society activities made the members proud of the organization to which they belong.

A rising vote of thanks to the speakers brought to a close a very educational and interesting evening.

Electrical Engineers Elect Officers

J. A. Johnson, Chief Electrical Engineer, Buffalo, Niagara & Eastern Power Corp., Buffalo, N. Y., was elected president of the *American Institute of Electrical Engineers* for the year beginning August 1, 1934, as announced at the annual meeting of the Institute held at Hot Springs, Va. The other officers elected were: Vice-Presidents W. H. Timbie, Cambridge, Mass.; R. H. Tapscott, New York, N. Y.; G. G. Post, Milwaukee, Wis.; F. J. Meyer, Oklahoma City, Okla.; F. O. McMillan, Corvallis, Ore.; Directors F. M. Farmer, New York, N. Y.; N. E. Funk, Philadelphia, Pa.; H. B. Gear, Chicago, Ill.; National Treasurer W. I. Slichter (reelected), New York, N. Y.

These officers, together with the following hold-over officers, will constitute the Board of Directors for the next administrative year: J. B. Whitehead, Baltimore, Md.; H. P. Charlesworth, New York, N. Y.; R. B. Bonney, Denver, Colo.; F. M. Craft, Atlanta, Ga.; A. H. Hull, Toronto, Ont.; R. W. Sorensen, Pasadena, Calif.; A. M. Wilson, Cincinnati, Ohio; L. W. Chubb, East Pittsburgh, Pa.; B. D. Hull, Dallas, Tex.; P. B. Juhnke, Chicago, Ill.; G. A. Kositzky, Cleveland, Ohio; Everett S. Lee, Schenectady, N. Y.; A. H. Lovell, Ann Arbor, Mich.; L. W. W. Morrow, New York, N. Y.; A. C. Stevens, Schenectady, N. Y., and H. R. Woodrow, Brooklyn, N. Y.

CANDIDATES FOR MEMBERSHIP

The Constitution of the Society as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 14 applications for membership have been received and the names of these men and their sponsors are published in the following list.